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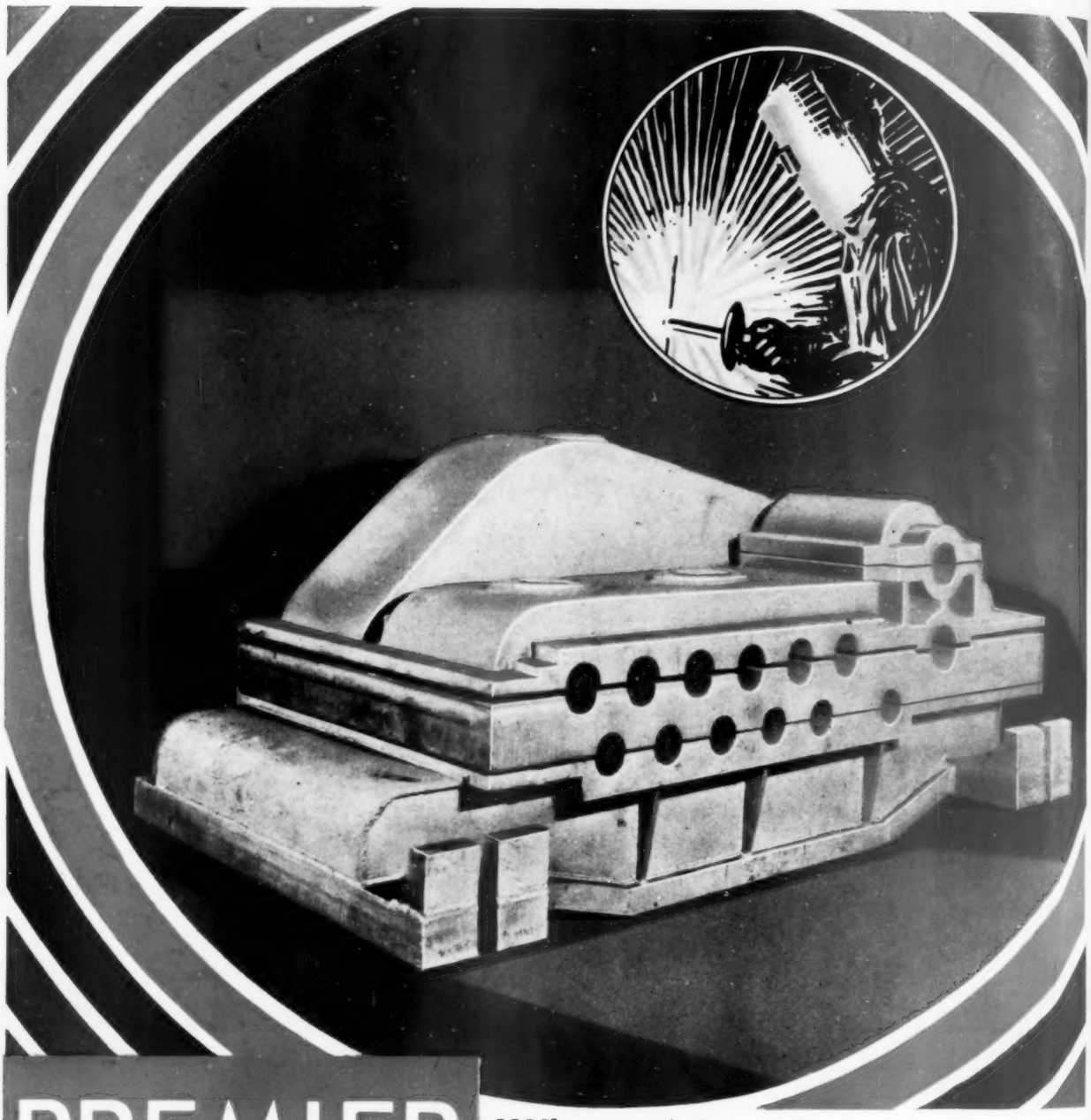
The Welded "Tank Beautiful" *(See Page 5)*

July, 1932



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The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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The Picture on the Cover*

"The Welded Tank Beautiful" (see page 24) sets a new standard in elevated tank construction. Here is a structure which actually beautifies the landscape, while serving the community in which it is located. Here also is an artist's ideal translated into a reality. And those features of the tank which distinguish it from its less attractive predecessors are fabricated entirely by welding.

Drawing by courtesy of Chicago Bridge and Iron Works.

HERE IT IS . . .

THE NEW

LINCOLN "*Shield-Arc*" WELDER

EDITORIAL

Work for the Schools

DESPITE the fact that the decline in production has left a good many skilled welders out of work and that they are standing in line for the first opening which may appear, there is plenty of good work for the trade and technical schools, and plenty of reason for spending time during the summer months in the improvement of training programs. As far as the engineering schools are concerned, there is obviously much to be done. Some of the largest of them are giving scant attention to these processes which are being used extensively on such important engineering projects as the construction of battleships, the Hoover Dam, the Boston Tunnel and countless smaller jobs. But while the engineer of the future needs to know the fundamentals of welding he does not have to be a skilled operator. With a recovery in industry skilled operators will be much in demand, and their skill is not to be based on the same conditions which obtained five years ago. Processes have changed, and materials have changed remarkably during the past two or three years. Newer methods have reduced the cost of welding operations to such an extent that the demand in the future will be for men who know these methods. Teaching programs therefore need to be revised so that these new methods will be taught. There has also been a steady trend toward the use of metals other than mild steel for many purposes, so the student has much more to learn about the differential commercial metals and alloys and methods of welding them. This is a new opportunity for the privately conducted trade school where welding processes are taught. These schools have always done their best work with students who were already familiar with welding operations, and were spending money to get a better fundamental knowledge, and to learn how to correct their faults. More of these experienced welders will be looking for good instruction in the future because employers are finding out the value of the qualification test, and operators are learning their own shortcomings from the same tests. The instruction programs for the coming year should be planned with great care if they are to meet the needs of this industry. In fact, it is altogether a question of good planning, because it takes no more time or money to do a good job than to do a poor one. Now is the time to be thinking about it.

Modernizing and Safety

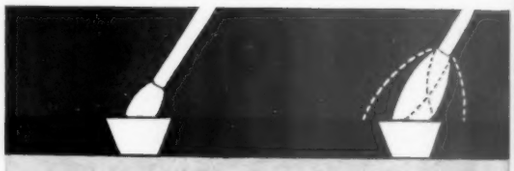
MODERNIZING may seem to be a formidable undertaking if it is literally interpreted to mean a general scrapping of all equipment so as to replace it with the latest in design. Considering the change which would be made in the employment situation if everybody did that, the experiment would certainly be hailed with delight by all the wage-earners in the country. The vision is worth mentioning because it is an extreme toward which the country is positively not working at the present time. It is working rather toward the other extreme of holding on to every piece of obsolete and antique equipment as long as it will operate, regardless of efficiency, postponing necessary repairs until an absolute breakdown occurs. Nobody can estimate the amount of money which is being wasted through this panicky supercaution against unnecessary expenditures. "Run it 'till it busts", is saving dimes this week so as to lose dollars next week. Often enough the loss is not only in efficiency but also in safety. This applies to welding equipment as well as to other plant equipment. Salesmen and service men have reported of instances of equipment in use being in such rickety condition as to be dangerous as well as inefficient. Unless these conditions are changed we will have a new series of accidents and casualties for which the blame will be placed upon the process or the particular make of equipment involved, instead of being placed on the management. As for plant equipment and machinery it is folly to avoid a minor repair which may avert a complete breakdown. It is infinitely worse to postpone such repairs when there is involved a hazard to the employes of the plant. If the management cannot see its way clear to finance a complete modernization, it should at least keep from slipping back so far that the common sense rules of safety are not observed.

Why Not?

A COMPANY which was organized for an entirely different purpose found itself head over heels in the fly-swatter manufacturing business this summer, as a result of a trifling incident in the main office. The result meant much employment and a tidy profit. It was a new product and the public liked it, and bought it. It takes just such a prosaic subject as this to illustrate clearly the opportunities which actually exist for doing business at a profit by offering the public something it wants instead of something it doesn't want. An illustration in our own industry is that of a large tank plant which has gone in for the manufacture of small steel houses. There isn't such a whale of a market for tanks these days, but the tank shop has a lot of equipment which can readily be used for making other products besides tanks. It seems like good common sense to find some other product for manufacture as long as the market for the old product is down. Welding equipment is just about the most versatile and flexible of all metal working equipment. It will manufacture a thousand different products, from fly-swatters to locomotives. If the market is gone for the product it was intended to manufacture, why not dig up a new product for it? The metal furniture plant has all the necessary facilities for making metal step-ladders and extension ladders or metal chicken coops. The boiler factory usually has welders who could qualify for bridge repair work. One large heating plant manufacturer is reported to be taking on the production of metal toys and novelties. The possibilities of keeping busy by pioneering new fields of demand are simply too numerous to mention. Can it be done? It is being done.

CLOSE CONTROL

enables you to deposit the metal exactly where it belongs



A *short arc*—this enables the welder to direct the flow of metal, with the result that all of it is deposited at the desired point.

A *long arc*—this makes it difficult to direct the flow of metal, with the result that only part of it is deposited at the desired point.

Only with *close control* of the welding current can you direct the deposit of molten metal to the exact point desired — one of the first essentials of a perfect weld. Moreover, *close control*—the outstanding feature of Wilson Welders—saves time, metal and money. Write to Wilson Welder & Metals Co. Inc., North Bergen, N. J., for complete information.

WILSON

ARC-WELDING MACHINES AND WIRE

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THE MONTHLY SYMPOSIUM

With the Welderies

Contractors

By R. A. Gast†

In the consideration of electric arc welding the factor of mobility of equipment has become of ever increasing importance, and the number of contractors who carry the welder out to every job is large. This is a far cry from the day when the process was the child of the laboratories and successful arc welding depended upon luck and the most exact environment. The years have changed all that. We now think of the arc welder as a portable all purpose tool. The motor driven models may be set at the foot of a tall building and the electrode holder carried up a half dozen floors. Where electric power is not available there are many types of gasoline engine driven welders which cost but slightly more to operate than the motor driven models and give equally good operating characteristics.

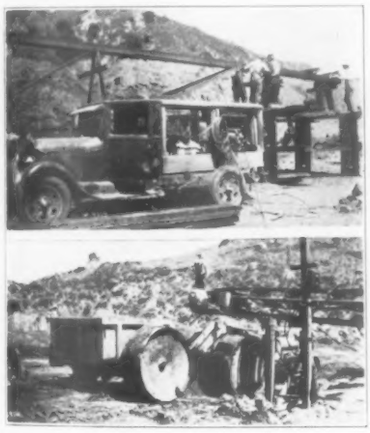


Fig. 1. Gas Engine Driven Unit Building Conveyor in the Field.
Fig. 2. Arc Welded Trucks and Barrows Withstand Hard Usage.

The result is that arc welding has interesting potentialities as the tool of the construction engineer who must be self-sufficient in the field, miles from his shop and base of supplies. Gasoline, procurable almost anywhere, supplies the power.

By this time you are asking—what will an arc welder do in the field? The answer is that the arc welder is the kit of the steel carpenter.

R. G. LeTourneau, contractor of Stockton, California, who is at present working on the Hoover Dam, builds his own field equipment which includes:

Grading equipment
Scrapers
Motorized belt conveyors
Dirt moving equipment
Trucks and trailers
Miscellaneous equipment

By using arc welding, this contractor is able to build his equipment of steel, standard structural shapes and bar and flat stock, and the resulting units being arc welded steel are extremely strong and durable. This is obviously a large factor in material handling, especially on projects which are not close to the shop.

Fig. 3. Arc Welded Scraper.

Fig. 4. Boom for Gas Shovel Fabricated from Steel Plate.

In Figure 1 the steel carpenter's tool is seen in action in the construction of an overhead dirt conveyor. The conveyor, of steel, will not break down under service and it can be cut down with the same welder that built it, when the job is done. The welding unit shown can be used for joining or severing metals or in depositing abrasion resistant hard facing to digging and cutting tools.

A conveyor of the type illustrated by Figure 1 is shown in Figure 2 operating over an all welded trailer built by Le Tourneau. The rugged appearance of this unit shows its serviceable qualities. There are no bolts or rivets to jar loose and no seams to invite corrosion. Such equipment is easy to build and presents a definite saving both in original cost and in maintenance.

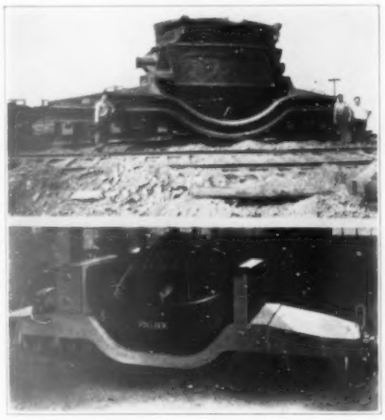
The more complicated grading unit shown in Figure 3 offers the same advantages. Except where interchangeability of parts is desired no bolts were used. The use of arc welding here eliminates the possibility of loose connections which would put the scraper out of service.

One of the characteristics of the electric arc process as a tool has been the fact that in almost every application it brings an improved product at lower cost. The boom for a gas shovel, shown in Figure 4, is composed of steel plate stock cut to size and arc welded. The boom is light, strong and rigid and again there are no joints to loosen. The welds are stronger than the members joined.

Perhaps the greatest test for arc welding as applied in the field is found in the construction of the great oil and gas transmission lines. Here the welders of the type shown in Figure 1 are run at continuous top speed in a wide range of temperature and weather conditions. The speed of the welding operation in pipe line construction is remarkably high and the welded connections show finer physical characteristics than the pipe metal.

Redesign Economies

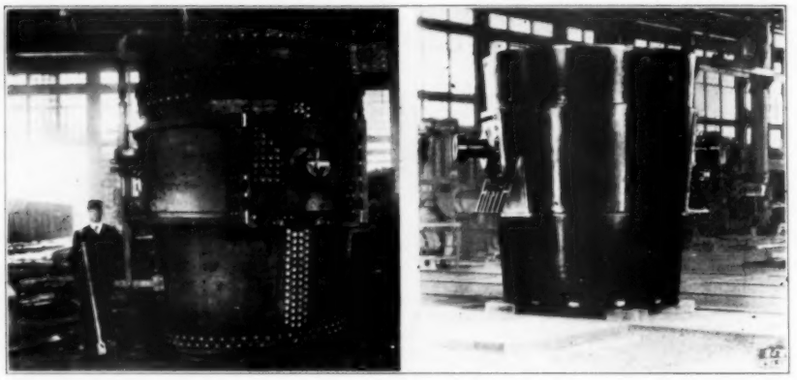
After an experience of 69 years fabricating thousands of pieces of heavy equipment for steel mills, blast furnaces, refineries, and other basic indus-



Figs. 1 and 2. Redesign Saved 5 Tons Weight and Increased Load 25 Tons.

tries, The William B. Pollock Company of Youngstown announces the establishment of a special engineering department to design every type of shop equipment for welded rolled steel fabrication. For the last ten years the company has studied the possibilities of this kind of construction, and the work

†Mechanical Engineer, The Lincoln Electric Company, Cleveland, Ohio.



Figs. 3 and 4. The Welded Ladle Shown Has the Same Load Capacity as the Riveted Ladle but Weighs Over Ten Tons Less.

turned out during this period demonstrates the strength and economy of the newer process of joining metals.

By redesigning the riveted cast steel hot metal car shown in Figure 1 for fabrication by arc welded rolled steel, a saving in weight of 10,000 pounds was secured. The newer type is shown in Figure 2. This saving in dead weight in the new design was achieved even with the addition of a tipping mechanism, and the capacity of the car was increased to 140 tons of hot metal. The riveted cast steel unit holds only 115 tons.

In addition to the economies shown here, the new car has other advantages such as the absence of possible hidden defects in steel castings. Such defects, if they exist, either remain hidden or show up when machining is well along, thus necessitating delays or added costs. Service has proven the welded rolled steel design to be stronger than the riveted type.

Figure 3 shows a riveted cast steel open hearth hot metal ladle—one of many built by The William B. Pollack Company. The dead weight of this ladle is 51,000 pounds, and the capacity is 85 tons of hot metal. Utilizing rolled steel and arc welding, the Pollock engineering department has redesigned the ladle as shown in Figure 4. This ladle has the same capacity as Figure 3, but the weight has been reduced to 30,000 pounds.

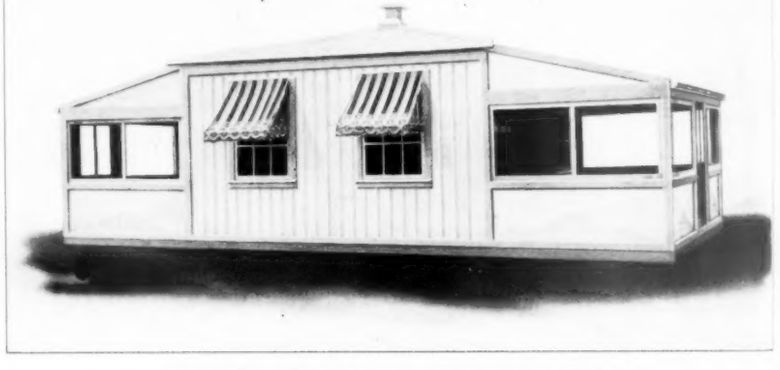
The Pollock Company, with its enlarged engineering facilities, is prepared to design special and standard equipment for every industry using riveted or cast steel equipment.

Steel Houses

The Columbian Steel Tank Co., Kansas City, Mo., have recently gone into the fabrication of portable steel houses for summer homes, industrials, and even for permanent dwellings. These houses were made up in sections having a standard base unit of 16 ft. square. The frame is of structural steel and the exterior walls of rolled steel sheets. The interior surfaces are of an insulating material.

Welding plays a very important part in the fabrication of these sectional steel homes. The building has top plates, bottom plates, corners, window frames and door frames of form structural members. These are all joined together by electric welding and the wall and roof sheets bolted to them. The sections are all made up in the plant and shipped to the building site in large pieces, ready for quick erection.

No welding is done on the building site. The frame bolts together and the outside members bolt on to it. The building is so designed that no raw edges are visible. It is recognized that the development of these metal homes is in the experimental stage, but this company is continually making improvements and expects this product to become one of the major outlets for steel in the near future.



Steel House Made by Columbian Steel Tank Co.

Maintenance Welding

Piping

By George F. Walker

It was desired to weld a 3-inch drip on the under side of an 8-inch main which was suspended in the air about 60 feet from the floor of a locomotive shop. This was a live main, so the work could not be started until the whole plant was shut down for the day.

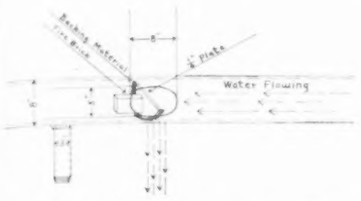
A staging was slung from the roof trusses to allow access to the work. The lines were shut off and the valves were closed; then the welding operator proceeded in the usual way to mark the location of the drip and cut the opening in the bottom of the pipe. It was expected that quite a lot of water would run out when the pipe wall was cut through. Then as soon as the flow of water stopped, the hole would be cut to exact size and the drip welded on. A piece of 3-inch extra heavy pipe 12 inches long, with a thread on one end, was used for the drip.

In this case the water continued to run longer than usual and the amount of flow did not decrease. An investigation showed that a valve on the return line was not holding, which meant that the water would continue to flow. Obviously it would be necessary to make some arrangement for drawing off this water before the operator could complete the weld on the drip.

The procedure was as follows: An elliptical-shaped hole was cut on the side of the pipe back of the drip location. The piece removed was 8 in. by 5 in. wide. This made it possible to build a dam inside the pipe, using a piece of ¼-in. plate cut to fit the inside curvature of the pipe. It was held in place by a fire brick placed on edge and backed with a quantity of putty and asbestos fibre.

This dam stopped the flow of the water through the pipe and backed it up so that it flowed out the side of the

pipe where the hole was cut. The welding of the drip now proceeded without difficulty. When this was completed and allowed to cool, the dam was removed and the water found its outlet through the drip. Of course, the water



How the Welder Detoured the Water While He Worked.

level dropped immediately so that the piece which had been removed could be welded back into place. Connections were made, the valves were opened and the job was pronounced perfect. What looked like a serious problem was overcome by a little ingenuity on the part of the welder.

Copper Tubing

By R. R. Shuman

Workers in brass, bronze and copper tubing are frequently confronted with splits in the tubing, either due to imperfections in manufacture, or developed by stresses in bending or fabrication.

A prominent Milwaukee brass works, now salvage all such tubing by brazing with Handy & Harman's "Sil-Fos" brazing alloy. In producing fuel and oil lines for automobile engines, condensing coils for electric refrigerators and similar work, they use large quantities of copper tubing and brass or bronze connections. "Sil-Fos" not only saves loss by speedy reclamation of damaged tubing, but is also used in correcting defects in brass and bronze castings, as well as brazing the joints, in assembling the parts. As an example of the latter use they report a typical quantity-production job in which 14 joints in a motor truck oil manifold are brazed at the rate of 35 seconds per joint. The manifold is 36 in. long, made from 5/8 in. copper pipe, with brass T's, and L's and crosses. This material is so extremely fluid at 1300° F. that the brazing is done in half the time that was formerly required. Its low brazing temperature also avoids damage to the parts contiguous to the joints brazed.

"Sil-Fos" is a patented alloy containing silver and phosphorus in combination with copper. The combination gives strength, ductility and penetrating qualities and lowers the melting point several hundred degrees below the temperatures required by spelter, bronze or other commercial brazing alloys. The phosphorus has a tendency to act as a flux, so much so, that most copper to copper brazing can be done without using any flux. However, in brazing other non-ferrous metals and alloys it is advisable to use a small amount of flux.

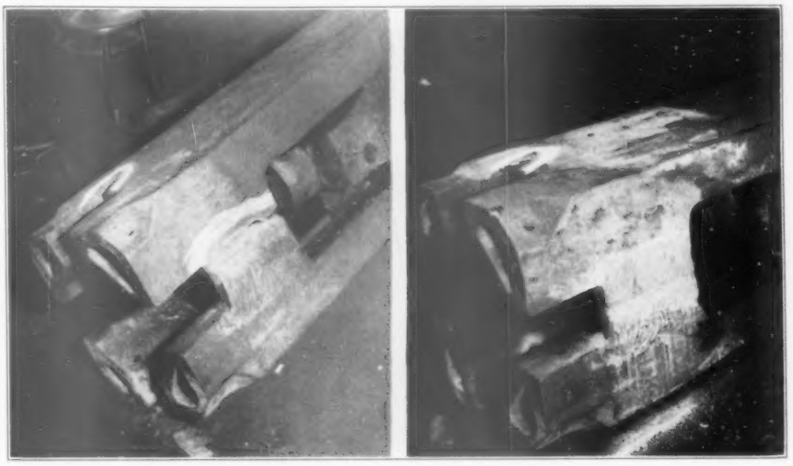
Pile Driver

Both the economy and durability of Tobin Bronze repair welding were aptly illustrated through two accidents which, at different times, disabled a steam pile driver.

In both accidents, a wrist pin, holding the hammer head to the plunger, broke, allowing the plunger to run wild and smash the heavy housing and other parts of the driver. In the first mishap, the cylinder head was cracked and the housing fractured in two places. The parts were repair welded with Tobin Bronze and the pile driver restored to service the same day as the accident.

Several months later, the wrist pin again gave way, this time not only causing fracture of the housing and cylinder head but of the cylinder as well. One of the most interesting features of this second accident was, that while the parts received a more severe hammering than in the first break, the fractures occurred outside of the previous repairs. In the case of the cylinder head, the cracks ran into but did not penetrate the repair welds. The repaired sections of the housing withstood the blows of the piston while the other sections, uninjured the first time, were broken in the second accident. The cylinder itself was badly broken in two places where there were stud holes.

The repair was accomplished in ten hours. This included seven hours of preparation by chipping by two men, and three hours welding by one operator. No preheating was necessary except that furnished by the welding torch and another torch played on the work during the welding. The cost of the repair was estimated by the welder to be about one-third what it would have been had ferrous rods been used.



Fractures in Housing Prepared for Welding and the Completed Job.

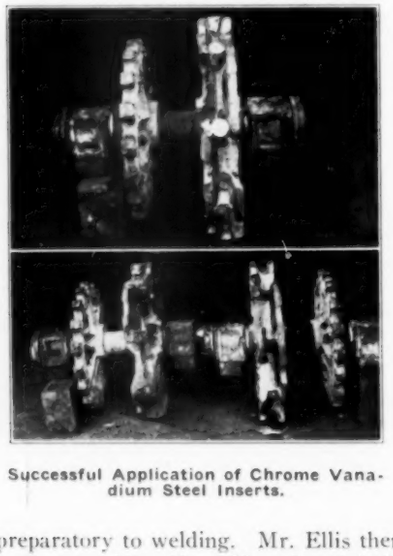
To eliminate machining in the repair of the cylinder, threaded carbon sticks were screwed into the breaks at the stud holes and the repair built up around the sticks. After the repair was completed, the sticks were burned out, leaving the rebuilt holes threaded.

Cylinder Head Prepared with Threaded Carbons in Place; the Welder at Work and Cylinder Head Restored to Service.

Sprockets

Mr. R. E. Ellis, proprietor of the Ellis Welding & Machine Company, Griffin, Ga., recently had the job of building up the worn sprockets of two large bull wheels from a steam crane working in his vicinity. From his previous experience, he had found that it was unsatisfactory to build up worn places of this description with welding rod only. He therefore devised a scheme

to utilize some discarded lengths of chrome vanadium steel shafting to keep the cost down on this job. From this material he cut short lengths and forced the pieces into the worn teeth of the sprocket gear. This is illustrated in Fig. 1. It will be noted here that the alloy steel pieces are tightly wedged in



Successful Application of Chrome Vanadium Steel Inserts.

preparatory to welding. Mr. Ellis then took some Una No. 155 rod and built up the teeth to the required dimensions. The finished work is shown in the left portion of the photograph, Fig. 2. The right portion of Fig. 2 shows the gear as it reached the shop and gives a good idea of the extent to which it was worn. Acknowledgment is made to R. G. Wilson, District Sales Manager, Burdett Oxygen Company, Atlanta, Ga., for the photographs and information concerning this interesting job.

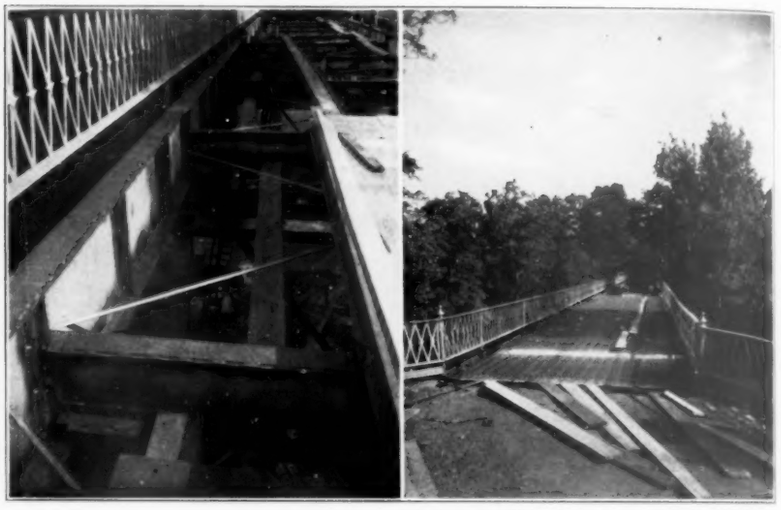
Bridges

Electric arc welding is being utilized to full advantage by the County Commissioners of Chester County, Pennsylvania, in the rebuilding of old bridges for carrying modern loads. One of these bridges, Laurel Bridge No. 54, was originally erected in 1887. This bridge, a viaduct type, constructed of wrought iron, has given good service for the past 45 years, but inasmuch as it was originally built for two-ton capacity, it was not heavy enough to carry the load demanded of it by modern traffic.

County Engineer Harry K. Ellis, together with the County's Consulting Engineer, Stacey H. Widdicombe, and the firm of Carson and Carson, of Philadelphia, redesigned the entire structure, utilizing welding as the means for making all new connections so that the bridge, when completed, will carry loads up to 15 tons.

The deck of the bridge is approximately 16 feet wide by 264 feet long. All of the floor beams and girders were strengthened by means of cover plates and stiffeners welded to the old members. The old floor beams were dropped to take new stringers of larger dimensions. All connections were welded. The old four-inch wooden floor planks are being replaced by a six-inch reinforced concrete deck. It is interesting to note that resistance welded reinforcing beams are used for the deck construction. These beams are, in turn, arc welded to the supporting structure.

The repairs to this bridge involve about 36 tons of new steel and the welding amounts to approximately 55,500 lineal inches. Four General Electric electric arc welding generators, gas engine-driven, are employed in the welding work, the bulk of which is being done with General Electric Type R welding electrode which produces a ductile weld eminently suitable for the impact stresses encountered in bridges. The repairs are being made by Charles H. Dunleavy, of Coatesville, Pa., and the welding is being done by Mellon, Taylor, and Hendrickson, Inc., of Philadelphia.



View from Above Showing Welding Details and General View of Bridge Showing Welded Deck Reenforcements Partially in Place.

Miscellaneous

Metallizing Made Practical in Pipe Line Work

The Metallizing Company, of Los Angeles, Calif., report the recent sale of one of their metallizing machines to the Southern Counties Gas Company for use in pipe joint coating. The gas company is constructing a pipe line at this time in which a large number of joints of the pipe have been treated with galvanizing to withstand corrosion. These galvanized joints will be used in the line for crossing bridges where the pipe will remain exposed to the excessive corrosive element of the salt sea atmosphere along the coast, and in crossing sloughs, etc. In welding the joints of galvanized pipe, a considerable area of the galvanizing is burned off. Also the weld itself, if left untreated, would be subject to early deterioration by the destructive elements mentioned. The metallizing machine is used to eliminate this condition by spraying a thin coat of zinc over the weld and burnt area of the pipe, giving it a complete 100 per cent zinc coating which will withstand corrosive action as well or better than the galvanized treatment of the pipe itself. Application of the zinc is by means of a zinc wire fed through the machine in which an acetylene flame provides the heating and melting element.

Phosphor-Bronze

By A. M. McFarland

THE possibilities of Electric Welding with phosphor bronze, seem to have been, to a large extent, overlooked by the average run of welding shops. This material has the advantage of fusing at a comparatively low temperature, and at the fusing temperature it will stick to steel wherever it hits. It makes a strong seam, with little or no porosity, and compared to steel welding, it is very fast; It has the disadvantage of costing more than steel, but at the present low prices, this disadvantage is frequently of little consequence, com-

pared to the saving in time, and some of the special advantages peculiar to this material;

Importance of Fast Work

For example, in welding galvanized steel materials, the bronze may be applied without removing the galvanizing; The seam may be welded at high speeds, and when it is finished, a close inspection will disclose that the bronze has covered the seam, and while some of the zinc has been oxidized, the bronze has alloyed with the zinc at the edges of the seam, and left a coating of brass extending out over the galvanizing, making a complete non-ferrous coating; When the bronze is applied in the usual way, by means of a flame, you will generally find that there is a narrow path of exposed steel on each side of the seam. It seems that the flame, travelling at slow speed, overheats the zinc, and either oxidizes or vaporizes a wider path than is covered by the weld. The electric arc travels at a higher speed utilizing the larger part of its heat in fusing the bronze wire or rod, and not burning away enough of the galvanizing to leave any exposed steel. The manipulation of this material is rather tricky, but once understood, it is much simpler than ferrous welding, and less subject to failures in the weld;

Automatic Head Recommended

The process is inherently adapted to the automatic welding machine. Some of the better hand-welders are able to learn how to hand-weld with the bronze rod, but it is difficult and tricky, because of the speed with which the rod melts away, and the irregular way in which fused and partially fused bronze breaks away from the rod. The difficulty resides in holding a steady arc under this seemingly irregular rate of deposition. However, when a good automatic welding machine is used, this trouble disappears. The automatic is able to control the feeding rate of the rod, and to easily overcome this trouble;

Technique for Galvanized Sheets

Examples may be cited, covering a wide range of welding conditions, but the process seems of especial advantage in welding thin galvanized sheets, ranging from 16 to 22 gauge, or thinner; The seam may be built up high and wide, but it is difficult to make it thin and narrow; Welding stock of the order of $\frac{1}{16}$" thick, welding speeds of from 4 ft. to 8 ft. per minute may be obtained; The bronze bead or seam may be of ordinary dimensions, or may be built up to about $\frac{1}{8}$" high by some $\frac{3}{8}$" wide, by regulating the speed and current. Welding wire of varying size may be used, but the smaller sizes must be fed very fast, to keep up with the fusion rate. A stock of $\frac{1}{8}$" and $\frac{1}{16}$" wire can be made to serve for a wide range of work. The welding arc looks like a short arc, as you watch it through a shield glass, but it will show about 30 volts on the meter. Evidently the resistance of the fused and partially fused material and the arc gasses is high.

Selection of Wire

It is necessary to obtain a suitable kind of bronze rod. Some of the rod sold for welding contains too much zinc, and will not arc weld at all. It completely disappears, without leaving any deposit. The right kind, for arc welding, is the kind that is sold by hardware and mill supply shops as "bronze spring-wire." It may be obtained from the brass companies, but it is best to first try out samples. Once the technique of handling the rod is mastered, it may be used in a general way, the same as steel welding rod is used. Seams may be welded with or without backing. The current may be regulated over a wide range, but only about ½ the amperage required for steel welding is necessary.

Because of the lesser heat required, there is less distortion of the job being welded. Ordinarily it will be found impossible to break the seam in the weld.

Welding Speeds

With a suitable automatic machine to feed the rod, welding rod as small as $\frac{1}{32}$" or even smaller, may be used, and current cut down below 50 amperes. Travel speeds must be slowed down until the deposit covers the seam to suit conditions. The bead will usually be higher and wider than you would like to have it, but this seems to be an inherent characteristic of the process.

There are ways by which the seam may be made thin and narrow, but they call for special equipment and especially designed apparatus. One of the methods sometimes used by the writer, is to lay a bronze wire flat along the seam to be welded, and fuse it down with a carbon arc, traversed over it. If the wire is of the right diameter, adapted to the job, the arc will travel on the wire, without burning the steel. It is usually necessary to rotate the carbon, to stabilize and concentrate the arc.

The writer has used this method for welding high carbon steel as thin as .015" (fifteen thousands).

Symbol Chart

On account of the fact that many people who order welding jobs done are not familiar with the welding processes, a great deal of confusion is caused by sending drawings of work to be fabricated by welding to the shops which are to do the work without going into detail as to how much and what kind of welding to use. In fact it frequently happens that incomplete instructions are sent to the welding department in the same plant. It is probable that this practice grew out of a situation where shop men knew more about welding than the men in the office. This condition probably exists in more than one shop today, in spite of the fact that it is just as sensible to tell a shop to rivet up a job without stating the size, number and spacing of the rivets as it is to make a notation to weld without stating the size of the fillet reinforcing, length of weld, etc.

This condition has been met by the St. Louis Structural Steel Company, East St. Louis, Ill., by the simple procedure of making up a large chart of symbols, using the standard symbols and nomenclature of the American Welding Society. The chart is prepared in blue print form on sheets about 2 ft. wide by 2½ ft. long. This large size makes it possible to use sketches and lettering which can be easily read. The symbols are arranged and classified in a manner which is considered best suited to the needs of this shop.

Commenting on their experience with it, Mr. H. A. Bradt, of the St. Louis Structural Steel Company says, "This chart has proven satisfactory and has eliminated a bad situation. In a very short period our drafting room became accustomed to using the symbols, and at the same time the necessity of using them created a desire as well as an obligation to know more about welding, the strength of welded joints, etc. This, of course, resulted in better construction practice and lessened the chance of failure. In the shops the results are still more marked. The welders know just what is required, the inspector has something to go by and we save the expense of a great deal of unnecessary welding. There is no one in this organization who would want to go back to the old way or who has any objections to the use of the symbols, either in putting them on the drawings or in interpreting them in the shop."

This experience illustrates the practical value of putting association work to good use. The American Welding Society has prepared a splendid collection of standard symbols for this very purpose and this shop which has taken the trouble to set up these symbols in a manner adapted to their own requirements has found it a simple way of eliminating a source of considerable irritation and extra expense in welding operations.

Welding instructors will see in this experience a lesson on the value of teaching standard symbols and standard nomenclature to students in all welding courses. The time is bound to come when employers will make this knowledge an important requirement and hold welders responsible for mistakes caused by ignorance of symbols used in written instructions.

The Welded "Tank Beautiful"

ELEVATED tanks are furnishing a fast growing field for welded construction, although comparatively few tanks have yet been completely arc welded. In a paper on "Plate Fabrication," read before the recent welding conference at Alabama Polytechnic Institute, Mr. H. C. Boardman, of the Chicago Bridge & Iron Works, stated that many elevated tanks have a central riser pipe connected to the middle of the bottom and supported on a center pier. Except for unusually large or high tanks,

Bottom of Tank Erected at Towson, Md., Shown Fitted up in the Plant.

the risers are seldom over $\frac{5}{16}$ in. thick. The majority of them may therefore be very effectively butt welded with no preparation of the plate edges than accurate shearing or square planing. The edges are simply butted together or nearly together and a light bead run on each side, the idea being not to add weld metal, but to fuse the plates together. Such joints in mild steel plate are 100 per cent efficient and are extremely ductile. Riser pipes made in this manner are for all practical purposes seamless cylinders of uniform strength throughout.

Coincident with the development of welded construction in the elevated tank field comes the beginning of a movement to make these tanks attractive land marks in contrast to the somewhat ugly structures which have been erected in the past. The Chicago Bridge & Iron Works recently sponsored a "Tank Beautiful" contest which aroused world-wide interest. Many designs were offered in this competition, the winner being the one shown on the outside front cover.

The attractiveness of this beautiful tower tank as compared to some of those which can be seen in almost any large city requires little comment. However, there is always the question as to the practicability of any design offered on this basis. In this case, the best answer to the question is the fact that the City of Baltimore, Maryland, has awarded contract to the Chicago Bridge & Iron Works for the construction of a tank based on this design. Practically the only difference between the original and the tank which is being built is that the original design was based on a tank of 200,000 gallons capacity and was furnished with a spiral staircase around the riser, whereas the tank ordered by the City of Baltimore has 300,000 gallons capacity and the tank is reached by ladder running up the side of one of the supporting columns.

The "Tank Beautiful" is being constructed in Towson, near Ware and Baltimore Avenues. It was approved as to design by the residents of Towson, the Baltimore County Commissioners, the Metropolitan Commission of Baltimore County and the City of Baltimore.

The Top Was Also Fabricated in the Shop.

The tank proper is 42 ft. in diameter and about 75 ft. high to the bottom and is supported by riser pipe 6 ft. in diameter and by ten columns. Everything is welded except the cylindrical part of the tank.

Each column is about 1½ ft. thick circumferentially, 8 ft. wide radially, and 72 ft. long vertically. The outer edge, consisting of a ¼-in. plate formed into a half circle is continued up the outside of the tank roof purely for

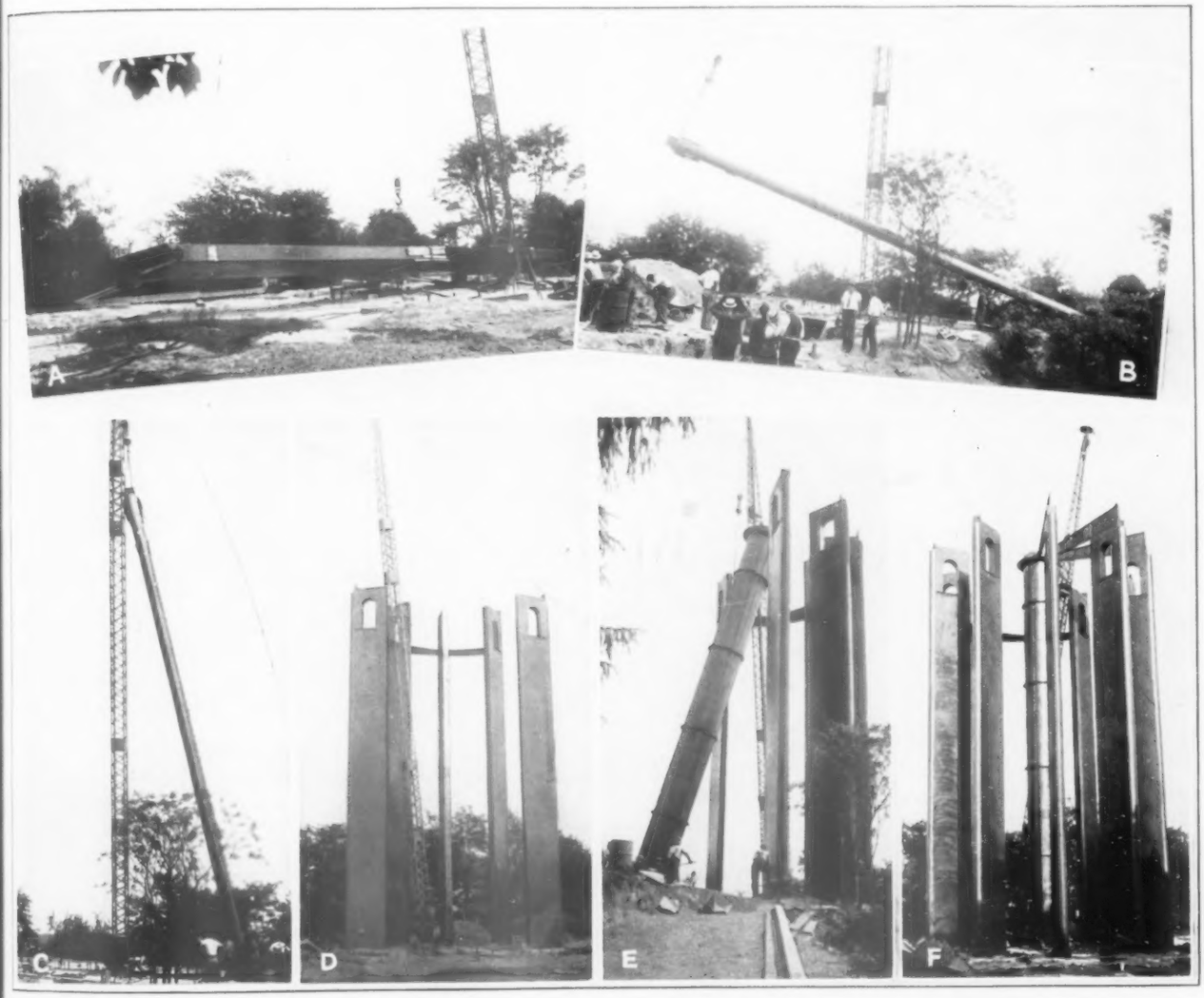
the sake of appearance. The sides are made of flat ¼-in. plates butt welded to each other and to transverse trusses spaced about 4 ft. apart vertically. The inner edge is a 15-in. channel. At the junction of the sides and the outer curved plate is a vertical truss consisting of two latticed angles. The inner surfaces were painted before assembly. The columns are hermetically sealed to prevent corrosion.

Resting on the columns and riser are ten radial girders supporting ten radial troughs which sag between the girders. The troughs are welded along their sides to the top flanges of the girders, along their outer edges to the tank shell, and along their inner edges to the riser. About 10 ft. below the bottom of the tank is a walk which extends through doorways cut in each of the ten columns.

This tank is connected with a fifteen billion gallon reservoir in Towson, and will feed water to what is known as the Upper Service Zone. The accompanying illustrations show the operations involved in raising the columns and riser to position and the construction of the bottom and the top of the tank. According to the contract, the complete structure is to be finished by the end of this month.

Welding Program for Olympic Visitors

The Executive Committee of the Los Angeles (California) section of the American Welding Society announces that two or more meetings of that section are being planned for the month of August, which sessions are being prepared especially in honor of and for the special benefit of the distant visiting members and others interested in welding, who will be in Los Angeles during that month to witness the International Olympic Games.



Views Showing Construction of First Prize Design Tank for City of Baltimore at Towson, Md. A—First Column Arriving, May 26th. B—First Column Going Up May 27th. C—Almost in Place. D—Five Columns in Place, June 1st. E—Six Columns in Place and Riser Going Up, June 2nd. F—Columns All Up and Three Girders in Place, June 3rd.

Several important and educational papers on various phases and new developments in welding, and covering many different lines of industry, are being prepared. The executive committee requested that all who are interested in these meetings, whether a member of the society or not, get in touch with either of the men mentioned below, as soon as convenient after their arrival in Los Angeles, and full schedules and programs will be supplied them.

It is also announced that arrangements have been made for escorting any or all who may wish to visit any of the industrial plants in the Los Angeles manufacturing dis-

trict. Free transportation for these visits has been provided, and a hearty welcome awaits all so interested.

The officers and members of the Los Angeles section listed below will gladly furnish full information regarding the August sessions as well as seeing that the proper reception is given all interested visitors. These men can be reached by telephone at their respective plants as indicated:

M. H. Turner, Home Oxygen Company, Huntington Park.

Turner M. Smith, General Petroleum Corporation, Vernon.

C. J. Nyquist, Weldcraft Service & Supply Co., Los Angeles.

G. J. Carroll, plant superintendent, Maywood Plant, Consolidated Steel Corp., Maywood.

Plan Definitely for Good Discussions at Metal Congress

Ample time for discussion of technical papers seems assured at the forthcoming National Metal Congress to be held in Buffalo the week of October 3. Not more than three papers have been scheduled for any one of the nine A. S. S. T. sessions, in response to popular demand for more time for written and oral discussion at meetings.

Reservations for exhibit space in the National Metal Exposition which will be held at Buffalo's 174th Regiment Armory, are steadily increasing. Over 90 companies have made space reservations. A large, attractive show is sure.

The following is a list of the A. S. S. T. papers which have been approved for presentation at the Congress. This, of course, is not the complete list as the tentative schedule includes 26 papers.

"Further Experiments on the Forgeability of Steel;" "A Simple Cutting Tool for Measuring Pressures in the Direction of Cut;" "Scaling of Steel at Heat Treating Temperatures;" "Transformation in the Carbide Phase During Graphitization;" and "Creep Characteristics of Metals at Elevated Temperatures."

"Behavior of Steel in Sulfur-Containing Atmospheres at Forging Temperatures;" "Development and Application of Marco-Etching;" "An Interpretation of the Deep Acid Etch Test as Applied to Tool Steels;" "Routine Disc Inspection in Quality Steel Manufacture;" "Autographic Stress-Strain Curves of Deep-Drawing Sheets;" and "Hardening Transformation in Manganese Steels."

"Observations on the Effect of Normalizing Medium Manganese Steels on the Microstructure and Physical Properties;" and "The Cobalt-Tungsten System."

More Ideals in Structural Steel Shop Fabrication

(The fifth in a series on "The Ideal Application")

By Paul B. Covey†

WELL, here we are back again in the land of make-believe. What were we looking at when we discovered that we must hustle away? Oh, yes, we were about to investigate the equipment supplied each welder. Let's see what this fellow has right here.

He has an electrode holder, of course, but one so different from what we are used to seeing. It is not much heavier than a good sized pencil. There must be some special insulation used, too, for although this welder has been using this holder almost continuously all day it is cool and pleasant to handle. The cable, too, is very light and extremely flexible—so unlike the heavy cables which welders find so hard to handle. There can certainly be no undue muscular strain in operating such a tool.

Do you notice, too, the height from the floor of all material to be welded? This has been so arranged that the welders do not have to break their backs stooping all day or cramp their leg muscles standing on their toes. Everything possible seems to have been taken care of to make this welding operation a pleasure to the operator. And why not? Isn't it true that the more comfortable his body is and the freer he can make his mind the more favorable are all conditions for the production of perfect welds? Of course it is.

They are such husky clamps, too, so strong and rugged, with deep throats, various width grips and quick acting screws—just the things for quickly clamping material together with full assurance that it will be held accurately and firmly where placed. Although extremely rigid they must be made of some special material for they are very light.

Then, see that large assembly rack. Yet it is so accessible—see the way it is laid out with aisles running through it in every direction for the assembly men to walk along in passing from one place to another without having to climb up and down all the time. And what a quantity of hook bolts for fastening down the material to the racks—jigs and clamps for holding the various members in proper position until tacked and ready for welding—and over-head hoists and rollers underneath for quick and easy shifting of parts from place to place.

Well, the time is getting short—we must pass on. Here we are just outside the end of the shop where all the finished material is conveniently laid out for final inspection. See how the material is laid out—high up from the floor so it is not necessary for him to lie on his back half the time looking for poor welds—all welds are readily accessible—no back breaking job inspecting those welds.

Suppose we step up and do a little inspecting ourselves on those good looking welds. They are hardly visible, they are so smooth and neat. And look at that apparent penetration—not much question about quality there, even to an inexperienced inspector. Did you notice the small number punched near each weld? That must be the welder's identification mark. I understand that by this method a careful check is made of each man's work and that his progress along the path of success is controlled by the reading of such a report.

I wonder what is going on over in that corner. Oh, a training school. Several men and a tutor, all working very carefully and in apparently close harmony, each trying to do his best to raise the quality of welding turned out from this shop. A mighty good idea. No wonder the finished welds look so good.

Next month we will let our minds wander once again in our search for "Still More Ideals in Structural Steel Shop Fabrication".

†*Consulting Welding Engineer, Manchester, N. H.*

New Economies in Elevator Installations

By J. F. Lincoln†

Figure 2. A Close-up View of Arc Welded Connection of Elevator Machine Beams to Structural Framework.

NEW and economical methods of elevator installation have been innovated recently in two large department store buildings in Cleveland. In the new Higbee store, a unit of the Union Terminals project, equipment for the operation of 25 elevator cabs was installed and the two story addition to the May Company necessitated the re-installation of elevator mechanism in 25 hatches.

Because perfect alignment of elevator machinery is essential, the structural members which form the hatch cannot be punched for elevator installation prior to erection.

It has been customary to drill the framework around the hatch and bolt machine beams, conduit brackets, counterweight and cab guide brackets into place, but on the Higbee job arc welding was introduced in two of these operations, so successfully that other applications suggested themselves.

The hoisting machinery for each elevator is supported by machine beams which rest on the structural framework above each hatch.

Each machine beam is composed of two channels toed in and bolted together with pipe spreaders. In the past it has been the practice to drill both the structural frame and the machine beams and bolt them together.

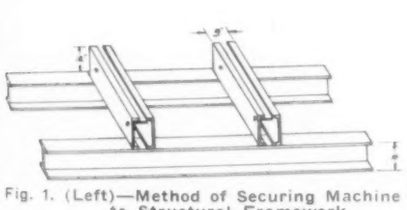


Fig. 1. (Left)—Method of Securing Machine Beams to Structural Framework.

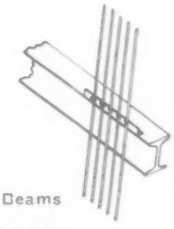


Fig. 3. (Right)—Conduit Guide Brackets Welded to Structural Frame Inside the Elevator Hatch.

There are in general two of these machine beams above each hatch. The custom is to drill two holes in each channel, one at each end, and four holes in the structural frame for each beam.

There are 25 hatches in the Higbee installation and it would have been necessary to drill 400 holes—half of them in the flanges of heavy structural beams.

Arc welding along the heel of each channel of the beams, as in Figure 1, at a cost of about 75c per weld proved quicker and more economical. Lincoln arc welding equipment was used to make the 200 required fillet welds.

The saving effected by arc welding on this operation was estimated at over fifty per cent.

Machine beams used on the May Company job differ from those used in The Higbee Company building, in that the former have shelf angles attached to carry floor slabs. Installation also differed due to rivet heads protruding above top flange of beams forming the structural framework. To clear the rivet heads small plates were arc welded across the bottoms of the machine beams and the plates in turn welded to the structural framework. Figure 2 illustrates this clearly.

The installation of 350 conduit brackets was also effected by the electric arc process. These brackets are pieces of angle iron about 12 inches long, punched before delivery on the job with holes in one leg for bolting to the framework and holes in the vertical leg for clamps to hold the conduits as shown in Figure 3.

The usual method is to drill two holes in the structural beam for every conduit bracket before bolting these angle irons into place.

One of these brackets is installed in every shaft on each of the fourteen floors. Using the electric arc process each bracket was fused to the framework with a fillet weld at each end of the angle iron. The work on both buildings was done by the Otis Elevator Company.

Arc welding might be further applied to elevator installation for the tying in cab guide brackets and counterweight guide brackets to the structural framework at each floor.

The cab guides in each hatch are tied in to the structural framework by means of heavy angle brackets. There are a pair of cab guides in each hatch, facing each other from opposite sides of the shaft.

The practice is to drill the framework and bolt the cab guide brackets in place. Where the shafts are side by side, as in the Higbee job, channel brackets may be substituted for angle irons on the beams which separate the hatches.

An almost identical problem is encountered at the rear of the hatch where the brackets which hold the counterweight guides are bolted to the frame at every floor.

The counterweight guides are supported by two brackets at each floor and only where the hatches back against each other is it possible to use channel brackets instead of angle brackets.

Both cab guide brackets and counterweight guide brackets could be fused into the structural framework by the arc welding process.

Door sill supports, usually bolted to the framework at the front of the hatch, have been secured to the structural member by the electric arc in several installations.

†*President, The Lincoln Electric Company, Lincoln, Ohio.*

Metallurgical Properties of Metals—and their effect upon welding operations*

By Joseph F. Osterle†

THE art of welding metals is passing through the same transition today that the metallurgical industry experienced fifteen or twenty years ago. From the use of welding on a small scale as a means of repairing, patching, or joining sheets, the art has progressed to the manufacture of large scale completely fabricated parts. In order to understand and apply welding metal intelligently, it is primarily necessary to know the metallurgical properties it possesses. From the viewpoint of chemistry, there are some seventy elements, pure substances, each having definite physical properties. These elements arrange themselves in groups the properties of which are somewhat similar for members of the same group. There are also definite natural laws governing the combination of two or more elements. Some of these elements are important in metallurgy; they have what is called metallic properties. While the laws for metallic combinations are also definite, they follow no general rule, and each is a study in itself. Pure metals are, in general, commercially unimportant. Most of our important metallurgical materials are combinations of two or more elements.

Properties of Metals

Some of the properties of metals which are of interest to all metal workers are: the temperatures at which they melt, the temperatures at which they boil, the quantity of heat required to heat them to certain temperatures, and the heat necessary to liquefy them when at the melting temperature or the heat necessary to vaporize them when at the boiling temperature. These values may be found in most technical handbooks. While there is no apparent correlation between these values for different elements, close examination proves that they follow the same chemical groupings mentioned above.

Other properties that have an important bearing on the combination of metals are: mass per unit volume; changes in length upon heating; ductility; hardness; tensile strength; capacity for conducting heat and electricity; malleability; color; and resistance to wear. Actual values for most of those properties are not plentiful. Much of this important and necessary information has not been experimentally determined. The future progress of the art requires that somebody undertake the necessary experimental work to determine these values.

Alloys and Combinations

As an example in considering the variant properties of metals, let us take an alloy of copper and zinc, commonly known as brass. The boiling point of zinc is below that of the melting point of copper. When brass is melted, the zinc vaporizes or distills from the molten mass. As a metallic vapor, it combines with the oxygen of the air upon reaching the atmosphere and is thus an economic loss. A large proportion of the investigative work on melting furnaces for brass during the past decade has been directed toward the recovery of this zinc. The general solution is to prevent oxidation, condense the metallic vapor in a cooler part of the furnace, and permit it to flow back into the bath. Another example of variant properties in metals is shown by that group generally called bi-metals. Bi-metals consist of two metals or alloys whose linear dimensions are differently affected with changes in temperature. These are welded securely together in comparatively thin sections. When the unit is heated, it bends in the direction of the metal having the least expansion, and this expansion property being a natural one, the movement is always the same and directly dependent upon temperature. Bi-metallic combinations are used in thermostatic regulation. If such a combination should exist in a welded joint, the tendency to movement would always be present during temperature changes, and even though the section were a heavy one, such internal strain could result in a rupture or breaking of the joint.

Metals combine with each other according to their variable degrees of attraction. The value of this attraction may be zero; it may be variable in proportion; or it may have definite proportions. While this statement applies to the solid state in particular, it is also true to some extent of the liquid state.

Attraction of Metals for One Another

When the attraction has zero value, the metals will not dissolve in each other. For example, sugar dissolves in water, but sand does not dissolve in water. The properties of a mixture, such as sand and water, are the average properties of the materials composing it. This mixture is often referred to as a conglomerate. Each component added to the mixture remains practically unchanged after the mass solidifies. An example is represented in the alloy of aluminum and lead. Aluminum and lead do not dissolve in each other. If a mixture of the two is allowed to solidify under conditions of slow cooling, they will separate and resolve into a mixture of comparatively pure aluminum and comparatively pure lead.

When the attraction is in variable proportion, the constituents may dissolve in each other completely or to a limited extent. The properties of these alloys, while continuous, are far from the average of the metals composing them, and approach a maximum or a minimum at some definite composition. There are two types of this variable attraction. There may be a direct replacement of atom for atom in the structure of the alloy, or there may be a dispersion of the atoms of one metal between the atoms of the other metal which we might call the prevailing type. All alloys in this class are called solid solutions. These alloys are important commercially for several reasons. Consisting as they do of metals which will dissolve in each other, they are naturally uniform throughout. Also, because of their solubility in variable proportions, they

*Paper read before the Second Welding Conference held at the University of Wisconsin, October, 1931.

†Department of Mining and Metallurgy, University of Wisconsin.

diffuse more or less freely in each other at elevated temperatures, and thus tend to eliminate some segregation produced naturally during solidification. A good example are the alloys of copper and nickel. The electrical conductivity of the alloys in this series approaches a decided minimum. This gives us our best electrical resistance alloys, one of which you may know under the name of constantan.

Metallurgical Compounds

When the attraction is in definite proportion, there results metallurgical compounds. These are new substances which have none of the properties of their elemental constituents. Take, for example, the compound composed of iron and carbon called iron carbide. It is the hard constituent of iron-carbon alloys known as cementite. It has none of the properties of iron nor none of the properties of carbon. It is a decidedly distinct substance in itself.

Pure metals are extremely soft. The attraction of like atoms is not particularly great. Solid solutions are generally harder and stronger than either constituent, because the attraction between unlike atoms is greater than between like atoms, and because the atoms of possible dissimilar dimensions key each other on atomic planes. Compounds are the hardest metallurgical products. The attraction of the unlike atoms is sufficiently strong to give them a fixed position with respect to each other. Just as pure metals are commercially unimportant, so are compounds. It is the combination of pure metals, solid solutions, and compounds that make up our commercial alloys.

Crystalline Structures

All metals are fundamentally crystalline. In cooling from the liquid to the solid state, the atoms change from random arrangement to orderly arrangement. This regular position represents the crystalline state of the metal, and the particular order of arrangement constitutes the particular crystalline system. Most metals crystallize in the cubic system, the fundamental unit of which is a cube. Some crystallize in the tetragonal system, a rectangular solid of variable dimensions, and some in the hexagonal system, a solid having at least six symmetrical faces. It must be understood that metallic crystals are small, that there are millions of them even in a small piece of metal, and that their growth to an external shape similar to their unit shape is prevented by contacts with other crystals. A unit crystal of any substance possesses perfectly definite properties. These properties are also directional, depending upon orientation with the crystal axes. In a group of unit crystals, having millions of atoms in orderly arrangement, one can cut various planes, some of which cut through many atoms and some of which cut through fewer. There are natural planes in crystals whose positions are determined by the number of atoms to be found upon them. When external forces are applied to deform metals, deformation takes place along the planes which offer the least resistance. The movement is referred to as slipping or gliding, and the planes called slip planes or glide planes. If during deformation the planes cohere, or stick together, the metal is ductile; if rupture takes place, the metal is brittle. If the application of external force is sudden and there is no opportunity for the planes of easy slip to absorb the shock, rupture occurs. If the application of the external force, however, is not too sudden, the resultant effect of the deformation is combined gliding and bending of the planes into the position of free gliding. In aggregates of crystals there is the additional effect of end resistance to consider. The continuity of crystal planes is interrupted, and gliding hindered. The smaller the size of the crystals, the greater the end effect, and hence the stronger the aggregate. Conversely, the larger the crystal size the less the end effect, the greater the unit crystal effect, and hence the weaker the aggregate.

Effects of Heat and Work on Crystal Size

Rapid cooling tends to produce small crystals. Slow cooling tends to produce large crystals. Where crystals exist under strain or undergo internal change with heat, a heat treatment affects crystal size, and in such material the tendency of the crystals is to grow larger. For various degrees of strain and various crystal sizes, there are definite temperatures at which the individual sizes or definitely strained grains will grow. Both hot work and cold work reduce crystal size. The natural strain produced by hot work is eliminated immediately while with cold work the strain remains in the metal. Some authorities claim that atomic fragments are also produced by cold work. Other authorities hold that the last liquid to freeze from a solidifying metal also takes random atomic orientation. In each case we have atoms in a decidedly unstable state, generally referred to as vitreous amorphous. Separating as they do, on the boundary betwen crystal grains, the atoms form a peculiarly hard cement which adds to the strength of the aggregate.

Where crystals are deposited without strain, and undergo no internal change with heat, heat treatment has little or no effect upon crystal size. As an example of a crystalline state, let us compare ordinary window glass with metallic alloys. Ordinary window glass solidifies from a melt with the same random orientation of atoms as existed in the liquid state. If crystallization took place, the glass would not become transparent, and for this reason we would not be able to see through it. The components of window glass are compounds which are not simple molecules. In order to crystallize, the various component atoms must come together in definite orderly arrangement. This action is far from a simple process and requires considerable time, with the result that the natural tendency of molten glass is not to crystallize but to solidify as a transparent solid. When pure metals or alloys crystallize from the liquid state, the molecules which must congregate or assume orderly arrangement are decidedly simple. They are composed of the smallest metallic unit, the atom. Therefore, crystallization of metals is a comparatively easy and simple process, requiring but little time for the atoms to become fixed in their proper crystalline place.

Impurities May Be Solids or Gases

Most metallic alloys contain non-metallic impurities. These consist of solids and gases. Considering that both are present within the limits of the best metallurgical practice, it is questionable as to which is the more harmful. Both, however, detract from the best qualities of metals; their elimination is a matter of economic expediency. The solids to be found may be weak metallic compounds having metallic properties and dissolving to some extent in the metals, or they may be non-metallic in character and entirely insoluble in the metal. Those dissolving to some extent in the metal generally form low melting

(Continued on page 39)

Accuracy in Mass Production

By W. T. Ober†

Line production of metal articles frequently makes it necessary that interchangeable parts be identical in dimension, to close tolerances. The precision of modern resistance welding methods in this field is remarkable. Mr. Ober tells how it is obtained.

THE degree of accuracy of dimensions or finish which may be obtained in resistance welding is remarkable, when the factors which enter into a resistance weld are considered. Butt welding, being somewhat older in common use than spot welding, and the later development of spot welding known as "projection welding," the demand for accuracy in alignment of the parts being butt welded, the maintaining of close tolerances on overall lengths and the limiting of the shape and size of upset at the weld, was a problem encountered by the manufacturers of welding equipment years ago.

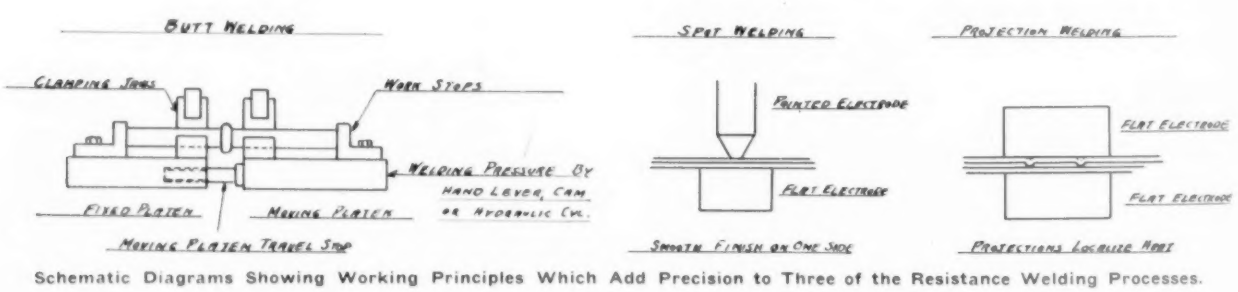
Platen Stops Control Length

In the earlier days of butt welding, most of the equipment employed was of the manually operated type, or, on sections too large to be upset by manual means, manually controlled air or hydraulic cylinders were used. Shafts, various parts of textile machines and other bar and rod members were held to overall lengths of plus or minus .005"—this accuracy being obtained principally by resorting to a positive stop, against which the moving platen, carrying one of work holding clamps brought up at the completion of the application of pushup pressure. By experimenting with the location of this stop, and determining the amount of shrinkage in the overall length of the welded bar as it cooled off, the close limits mentioned above were obtained. In this way, it was and is possible to weld completely finished parts, making it unnecessary to perform a subsequent machining operation to obtain the proper overall lengths.

Accuracy in Abutting Alignment

The matter of obtaining accurate abutting alignment of the part was somewhat more of a problem. This was obtained, however, within a tolerance of a few thousandths of an inch by means of very rugged equipment which would withstand the welding or upsetting pressure without unduly deflecting any parts of the welding machine. This necessitated not only bulk and rigidity in all of the parts of the equipment, but also, provisions for fine and accurate adjustments were provided which permitted the raising or lowering of one of the clamping members of the machine and adjustment of one or both members in all four horizontal directions.

As the jaws—or as they are commonly referred to—dies, of the welding equipment are usually made of copper, or a copper alloy somewhat harder than copper, and are the parts subject to the great wear, it is necessary to maintain the surfaces of these jaws or dies carefully, otherwise the accuracy of alignment is quickly lost.



Schematic Diagrams Showing Working Principles Which Add Precision to Three of the Resistance Welding Processes.

Cam Pushup Makes for Precision

As the demand for greater production per welding machine increased, the manual or semi-manual type of equipment was replaced to a large extent with machines having motor driven pushup device. This power driven pushup usually employs one or more cams for obtaining the movement of the sliding platen and clamp, and the pushup pressure. The cam, being generated to provide fixed travel or movement of the platen, automatically determines to a large extent the amount of takeup and

†*Works Manager, Thomson-Gibb Electric Welding Co., Lynn Mass.*

upset at the weld, which results in the welded article being held to close lineal dimensions, or circumferential dimensions if the part welded is a cylinder.

With no other provisions than the cam, the same degree of accurate lineal or circumferential dimensions can be obtained as is obtained through the use of positive stops for the platen movement. Copper alloys having great wear resistance qualities have been developed, thus permitting a long period of accurate alignment of the work holding jaws or dies before it is necessary to remachine or adjust them.

Material as thin as .005″ or .006″, of not too great width, can be butt welded by the flash method and alignment within .001″ or .002″ obtained and maintained for a considerable period of time. Sheet metal 10 ft. in width by only approximately .050″ thick is being commercially welded, the upset removed, and then the entire sheet stamped or formed into parts, without any difficulty, due to misalignment of the abutting edges of these thin wide sheets. This is a good example of the accuracy of alignment which may be obtained.

Flat Electrodes Produce Smooth Spot Welds

In the use of equipment commonly known as spot welders or projection welders, it is often necessary to obtain welds where one surface of the two parts being welded must not show any markings or indentation—perhaps because the parts are to be nickel or chrome plated or otherwise finished to obtain a mirror-like surface. This accuracy of finish is obtained in several ways: one,—perhaps the oldest, by using a large flat electrode on that surface which must be left unmarred and using the more pointed electrode on the opposite side. It requires a machine of proper electrical capacity with pressure and volume of current adjusted correctly and the weld made quickly to obtain these results. These results may be better obtained by resorting to the use of projections or, as some term it, reliefs, on one of the pieces. These projections may be from one to many in number. Whether one or many projections, the welding electrodes are usually flat on their faces where they contact with the work, and of sufficient area to cover all of the projections being welded. In some cases, instead of the electrode faces being flat, they have fairly large facings or inserts of a material harder than copper, as this facilitates the dressing of these surfaces or their replacement when they have worn.

The projections serve to localize the points of contact between the two pieces to be joined, therefore concentrating the current flow and the resulting weld, at these points. Because of the reduced area of contact between the pieces and because these projections heat very quickly, the amount of heat and the area of heated material in the piece requiring a smooth surface is reduced to a minimum, and therefore, the contraction of the material at the weld is reduced, and the flat or finished surface is not marred sufficiently to require more than a slight buffing operation to prepare it for plating or other finishing. The more quickly the welds are made, the less likelihood that any marring will result.

Uniformity Improved with Modern Equipment

Recent developments have made it possible to procure welds in one cycle or less of current flow of sixty cycle frequency and to obtain very accurate control of this current flow, thus insuring almost absolute uniformity of welds over a long period of operation and greatly improve the metallurgical characteristics of the weld metal. To obtain any of these accurate results, there must be a close and accurate control of the electrode surface and the volume and time of flow of current, as well as the amount of pressure applied to the work.

A very great degree of accuracy as to the reduction in thicknesses of the parts being spot welded, as, for example, in the welding of two rods or wires in a crossed position encountered in all fabric or bar mat welding, can be obtained by mechanical means—the welding current being turned on automatically after a predetermined pressure has been applied to the work, and shut off after a predetermined movement of the electrodes toward one another, caused by the softening of the rods or wires as they heat.

IN MEMORIAM

William A. Slack

Wm. A. Slack, President of the Torchweld Equipment Company, Chicago, Ill., died after a short illness at St. Joseph's Hospital, Chicago, on Tuesday, June 21st. Mr.

William A. Slack.

Slack was born in Chicago in 1875, and with the exception of four years spent in Philadelphia and three years on the Pacific Coast, has been a resident of Chicago all his life. He started a successful sales career early in life and built up a wide acquaintance in the manufacturing and jobbing trade throughout the United States. He be-

came associated with the oxy-acetylene welding industry at its very beginning and was one of the organizers of the Torchweld Equipment Company when that company was formed in 1917. At that time he was secretary of the company, and a few years later was made president, which position he has held up until the time of his death.

In the oxy-acetylene industry, Mr. Slack was widely known as a hard worker and a splendid friend. His interest in the welfare and progress of the industry was unfailing, with the result that he was constantly subjected to responsibilities and association work as an executive and as a member of many committees. His activities in such work were always characterized by the expression of high ideals in manufacturing and merchandising and warm friendliness toward all of his associates.

He was a member and director of the American Welding Society and one of the founders and directors of the Chicago Section of that society, past president and director of the International Acetylene Association, and a member of the Compressed Gas Association. He belonged to the Columbia A. F. & A. M., York Chapter Columbia Commandery, the Medinah Shrine and B. P. O. E. He was a member of the Medinah Athletic Club and the Ridgemoor Country Club of Chicago, and the People's Church, Chicago. The welding industry has lost one of its outstanding active workers, and many of the individuals of the industry feel a distinct personal loss with the passing of Mr. Slack, whose genial and kindly friendship invariably reflected a sincere interest in the welfare and happiness of his fellowmen.

Mr. Slack is survived by a widow, Mrs. Alice B. Slack, and brother, Chas. C. Slack of Chicago.

Boston Tunnel Has Arc Welded Liner

In approximately a mile of tunnel there are 133 miles of welds made by the electric arc. The tunnel, a new vehicular tube, is now under construction for the City of Boston. The tube contains a 21½ ft. roadway which ducks into the earth at Cross Street, Boston, runs underground beneath Boston Harbor for about 4000 feet and emerges at Porter Street, East Boston. It is reported

Fig. 1. 31-Foot Diameter Steel Rings Form Tunnel Lining.

that use of arc welding in the construction of the steel liner for this tunnel will help materially to effect a saving of approximately a million dollars.

The steel liner for the tube, as shown in Figure 1, is

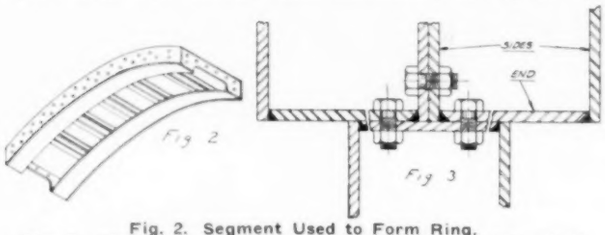


Fig. 2. Segment Used to Form Ring.
Fig. 3. Continuous Weld on Outside Segment Makes Tight Connection.

formed by rings, 31 feet in diameter, which are composed of panel segments. There are eleven panel segments in each ring. They are 2½ feet wide. Ten of the segments are uniform, the eleventh being a special key segment. Each segment weighs 250 pounds; 12,500 tons of steel being required. The segments were designed and fabricated by the Commercial Shearing and Stamping Company of Youngstown, Ohio, who also produced the steel liner for the Detroit Windsor vehicular tunnel, which is approximately the same design as the Boston job.

Rings composed of these panels are used as the lining behind the hydraulic jack driven shield which excavates the tunnel. When the tunnel is finished these rings form a gigantic cylinder. Because the rings are composed of segments and these segments are flanged the cylinder is stiffened every 30 inches where the sections are bolted together.

Formerly these rings were made of cast iron. The use of a fabricated steel ring allows a saving in weight of 66 per cent and lowers the cost of the tunnel lining about 50 per cent. There are, of course, other savings in shipping and handling.

Fig. 4. Completed Segments Ready for Shipment.

While these forms do not alone form the shell of the tunnel, they carry a tremendous load during the excavating. As soon as the tube has been completed an 18 inch layer of concrete on the inside of the forms supplements the steel.

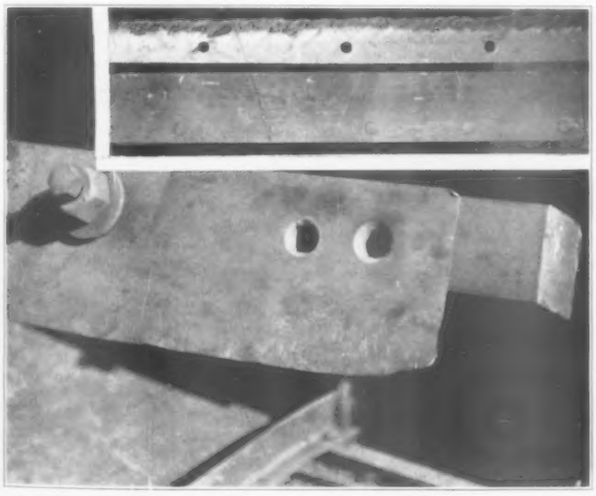
The segments are made up as shown in Figure 2, an isometric drawing. The skin plate is ⅜ inch thick. The stiffeners are 45 lb. A.S.C.E. rail and are arc welded to the skin plate with tack welds.

(Continued on page 40)

Stop Wear and Save Dollars

Have you a little gas tax in your state? Are all the corners watched in spending it? Here is proof that you can get more miles per dollar by using hard facing on highway equipment.

ROAD making and excavating equipment, regardless of whether it is publicly owned or privately owned, is subjected to such terriffic punishment in service that only the most careful management will prevent excessive repair or replacement costs. On account of the savings made by hard surfacing other kinds of tools which are subjected to abrasive wear, there have been numerous investigations of the possibilities of this welding application for reducing costs in the field of highway construction and maintenance.



Blade Bolted to Stiffening Bar to Prevent Warpage. Inset Shows Comparison of Worn Out Blade and New Blade.

Some of these experiments have been successful and others have not been successful, with the result that hard facing is considered highly important in some localities and of doubtful value elsewhere. In general, it should not require more than one experience over a period of years to establish the fact that it is entirely possible to make real savings. This means that the individual contractor who does not go to the trouble of finding out just how to do this work carefully, or where to get it done correctly, must sacrifice some of his profits on account of being unwilling to learn how to reduce his machinery maintenance cost. In the case of publicly owned equipment, it means that the tax dollar is not going as far as it should go.

Among the uses of hard facing materials which have been recommended are applications to grader blades and scarifier teeth. In Kings County, California, these applications have been in successful use for several years and their experience furnishes some convincing figures relative to the amount paid for blades before and after. In a letter recently written to Stoody Company, Whittier, Calif., Mr. Arthur G. Meldrim of the Kings County Purchasing Department, stated that during the fiscal year of 1928-29 they purchased $479.22 worth of grader blades, and then traced the history of the use of Borium, a hard-facing material made by the Stoody Company, since that time.

Appearance of Overlayed and Unoverlayed Teeth After Less Than One Half Mile of Scarifying.

It appears that during the following year they learned of the use of this material, and in the latter half of that year started using it on blades. The result was that the outlay for blades in that year was $280.36. During the fiscal year just past, very few blades were put on the road unless they were overlayed with Borium, and in that period the expenditure for grader blades was $135.85. These figures show a 75 per cent saving in the cost of grader blades over a period of three years, and it is also

pointed out that they were operating more road grading equipment last year than in the year 1928-29.

Soil conditions in King County, Calif., vary from one part of the county to another, just as they will anywhere. However, it has been estimated that the ordinary stock grader blade will grade about 15 miles of road before being entirely depleted. It is also estimated that on an average, a grader blade which has been properly hard surfaced will grade more than 100 miles of road.

Note How Constant Rolling of Earth upon the Teeth Has Worn into the Metal above the Borium Overlay.

Contrast Between Scarifier Teeth Overlayed with Tube Borium and Unoverlayed Teeth.

TABLE I

100 Miles of Road Grading

Cost of Borium Overlayed Blade

1 10 ft. Grader blade	$ 8.51
3½ hrs. putting on Borium at $1.30 per hr.	4.55
7½ lbs. 30-40 Borium at $5.00 per lb.	37.50
Oxygen, acetylene and torch charge	14.00
	$ 64.56

Cost of Regular Stock Blades

7 10 ft. Grader blades	$ 59.57
75 Re-sharpens 1¼ hrs. each at $1.30 per hr.	121.87
81 Changes (6 for new blades)	81.00
	$262.44

Table I is a comparison of the cost of a blade together with the Borium coating against the cost of enough stock blades and resharpens to complete a grading job of 100 miles. When referring to this table, it should be kept in mind that probably the largest item of economy is the fact that when a blade is in continuous service there is being saved many hours of time which would be spent in changing blades and having them resharpened if the stock blade were used.

In Table I the cost of each change of blade is estimated at $1.00. This charge is considered a very nominal one because the entire crew is held up when the change is made. There are also special trips to the machine shop, which mean an additional cost. Without taking into consideration the additional costs of wasted time by road men when these 18 changes and 75 resharpens are going on, it is still possible to show a per mile cost of blade alone of 64 cents per mile against a cost of $2.62 per mile by using stock blades.

It is stated by Mr. Meldrim that they have been able to make savings on scarifier teeth as well as on grader blades. In fact, it is indicated that the success with teeth has been even more gratifying. One set of teeth which was used by a road district for the entire spring and summer oiling season of 1931 has a staggering total of miles to its credit. To compare the cost of these teeth with stock teeth for the same period of time and the same length of mileage graded would make astonishing figures.

The plant where all this work is done is very moderately equipped. It has no special or expensive welding apparatus, but merely a standard oxy-acetylene welding torch. The operator's experience with th welding torch is comparatively short. He is a blacksmith by trade. The conditions were, in fact, unfavorable to the introduction of any process which required a large investment or which involved difficulties in operation. The simplicity of the operation had a lot to do with making a start, just as the savings which have been made have resulted in their finding use for several hundred dollars worth of the material during the past year.

Supplementing the above information, officials of the Stoody Company have called attention to the necessity for using the right material in the right place and for applying it according to the procedure which has proven successful. With particular reference to Borium, they state that it should be applied to the front edges of the scarifying teeth and grader blades and that both grader blades and scarifying teeth should be tilted back sufficiently to make the heels of the tools drag, thereby undercoating the soft steel back of the Borium applications, which keeps the tools constantly sharp during operation.

Unusual Applications

A recent issue of Industrial Gases, London, describes a number of interesting and useful applications of welding and cutting torches: Hinges are made with a cutting torch; a firm in Aberdeen makes welded floats for fishing nets; a skate manufacturer brazes blades to the soles and heels of skates; a golf club finds continuous use for the torch in maintenance work; two firms are welding milk bottle carriers for attachment to motorcycles used for milk delivery; a blacksmith is using a welding outfit to make incubators for poultry farmers; another is using the torch to build up studs on the shoes of hunting horses; electrical equipment manufacturers are welding up cast iron fuse boxes used in mining signals.

Detailing, Listing and Ordering of Machinery Parts for Welding

By G. B. Cramp†

IT IS sometimes generally stated that the preparation of detail drawings for welded steel machinery parts requires less time than details of cast machinery parts. This is true in part only, for many considerations determine the proper procedure for the complete detail, listing and ordering of the pieces entering into the construction of welded steel machinery parts. IMPORTANT CONSIDERATIONS.

First, it must be borne in mind that unlike cast parts, welded steel machinery parts, or weldings as they are beginning to be called, are composite pieces, usually comprising two or more pieces of plate steel welded together; and in this respect their proper and complete detail, listing and ordering must follow somewhat the established practice in detailing, listing and ordering structural work, or steel platework.

The second consideration is that of the origin of the design and detail itself. If the design and detail of a piece of machinery to be produced by welding should originate in a consulting or contract engineering office having no affiliated shop connections, and for this reason the design and detail drawings, particularly the latter, are to be submitted to possibly several shop and mill firms for estimated costs and finally for actual supply of material, welding and machining of parts, then the information to be furnished on the details of the weldings can seldom be too comprehensive or complete, for shop practice in handling this relatively new line of work has not yet crystallized to any specific standard practice.

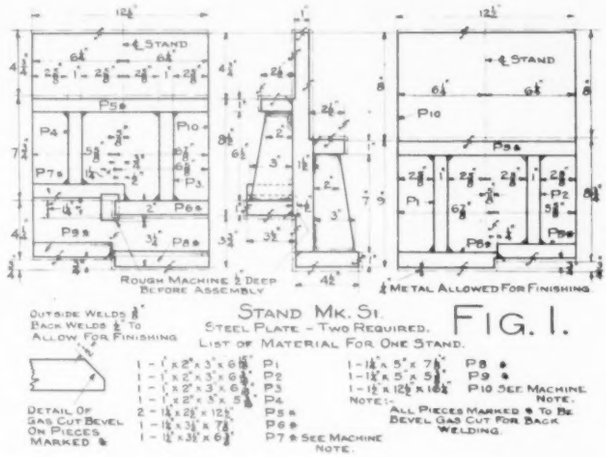
A third consideration should be rather a warning that while a welding eliminates the work of a pattern maker and molder, it places an added responsibility upon the draftsman in that he must fill with adequate and complete information, the present existing gap between the engineering department and the first mechanics in the line of production who are not at present as highly developed a class of mechanic as will eventually be developed in this relatively new field of machinery production. The mechanic who will be thus evolved will probably be known as the template taker. He may come from the ranks of present template makers, layers out, or possibly from those of the pattern makers or draftsmen.

Drafting Work Saved by Template Taker

When such a highly skilled mechanic as the template taker shall have been fully developed and is employed by the mills and shops furnishing gas cut steel plates in various shapes and thickness for the construction of machinery therewith, much time and drafting work will be saved in the engineering department and the belief that welding drawings can be made more cheaply and rapidly than drawings of cast designs, will be much nearer to actual realization.

In the absence of such a mechanic however, it will be incumbent upon the detailing draftsman to supplement his detail drawing with template sketches which will show the outline of every piece, especially the most intricate shapes, entering into the construction of each detail part, so that the less highly developed layer-out or template maker, usually employed, will be easily able to lay out the pieces required.

Sometimes the template sketches might be nothing more than rectangular shapes, or possibly circular shapes, in


STAND
ROUGH MACHINE ½ DEEP BEFORE ASSEMBLY
¼ METAL ALLOWED FOR FINISHING
OUTSIDE WELDS ⅜" BACK WELDS ½ TO ALLOW FOR FINISHING
STAND MK. S1.
STEEL PLATE - TWO REQUIRED.
LIST OF MATERIAL FOR ONE STAND.
FIG. 1.
DETAIL OF GAS CUT BEVEL ON PIECES MARKED ♦
1 - 1" x 2" x 3" x 6⅛" P1
1 - 1" x 2" x 3" x 6⅜" P2
1 - 1" x 2" x 3" x 6⅝" P3
1 - 1" x 2" x 5" x 5" P4
2 - 1½" x 2½" x 12½" P5 ♦
1 - 1½" x 3½" x 7⅛" P6 ♦
1 - 1½" x 3½" x 6⅜" P7 ♦ SEE MACHINE NOTE.
1 - 1½" x 5" x 7½" P8 ♦
1 - 1½" x 5" x 5½" P9 ♦
1 - 1½" x 12½" x 18½" P10 SEE MACHINE NOTE.
NOTE:- ALL PIECES MARKED ♦ TO BE BEVEL GAS CUT FOR BACK WELDING.
MACHINE BEFORE ASSEMBLY.
TEMPLATE OF PLATES P10. TWO PLATES REQD.
TEMPLATES OF PLATES P1, P2, P3 & P4. TWO PLATES EACH REQD.
TEMPLATE OF PLATES P7. TWO PLATES REQD.
FIG. 2.
BEVEL GAS CUT.
TEMPLATE OF PLATES P5. FOUR PLATES REQD.
TEMPLATE OF PLATES P9. TWO PLATES REQD.
TEMPLATE OF PLATES P8. TWO PLATES REQD.
TEMPLATES OF PIECES ENTERING INTO CONSTRUCTION OF STAND, MK. S1, FIG. 1.

Figs. 1 and 2. List of Materials and Templates for Gas Cut Parts.

which cases the detail of the composite part need be accompanied only by a list of material, or pieces comprising the part.

Requisites of a Welding Detail

Even though it might be considered unnecessary to accompany the detail parts with either a list of material

†Chief Draftsman Maintenance Engineering Dept., Lukens Steel Co.

or template sketches, the detail of the welding is not altogether simple, for it must then furnish—

(1) All dimensions for gas cutting the various shapes required and show the allowance for machining or finishing, either by note or graphically.

(2) It must show all necessary and adequate welds and give sizes for same as well as designate where pieces must be beveled by gas cutting the proper edges so that a recess is provided in which a back weld may be placed. Adequate dimensions for unfinished or rough sizes of the part must be given to assist the weld shop assembly mechanic in setting up the pieces to form the composite detail part.

(3) All necessary finish marks and machining operations should be shown so that the same detail drawing that is used for gas cutting pieces, assembly and welding, may be used in machining. All pre-

template sheet of such pieces, as is shown in Fig. 2, especially when the part is so simple and as completely detailed as is the Stand S1, shown in Fig. 1, but where more complex machine parts are involved, the possibility of error at the mill is greatly enhanced when no template sketches accompany the detail. Such errors result in considerable delay, inasmuch as the pieces on which the error has been made, must be refurnished by the mill. As one of the great advantages of weldings is the speed at which they can be produced, it is important that all information possible shall be supplied in order that all chance of error or misunderstanding between engineering office, contract shop and mill, shall be avoided.

The Stand Mk. S1, Fig. 1, as detailed, necessarily shows more detail dimensions than if this part was to be of cast metal. The rib pieces Mk. P2, P3 and P4 must be dimensioned at both top and bottom and by referring to the bill of material it will be seen that the lengths of these

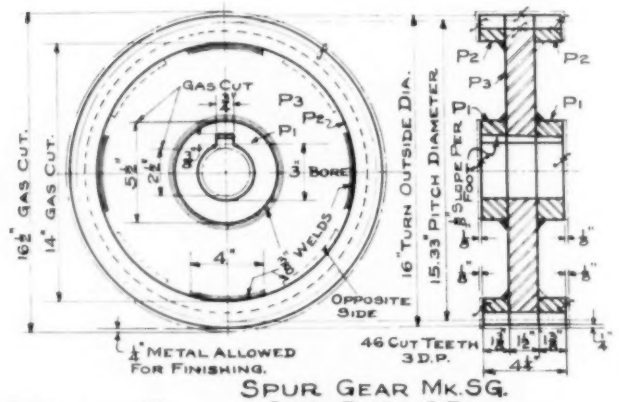
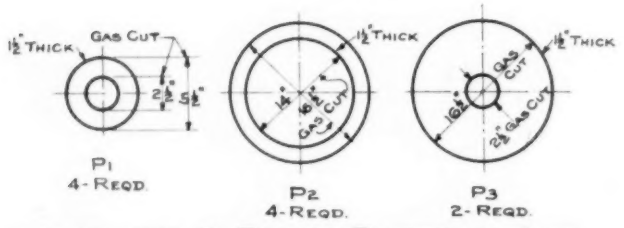


FIG. 3.

SPUR GEAR MK.SG.
STEEL PLATE 2 REQD.
LIST OF MATERIAL FOR ONE GEAR.
2 – 1½" x 2½" I.D. x 5½" O.D. P1.
2 – 1½" x 14" I.D. x 16½" O.D. P2.
1 – 1½" x 2½" I.D. x 16½" O.D. P3.



TEMPLATES OF PIECES ENTERING INTO CONSTRUCTION OF SPUR GEAR MK.SG.

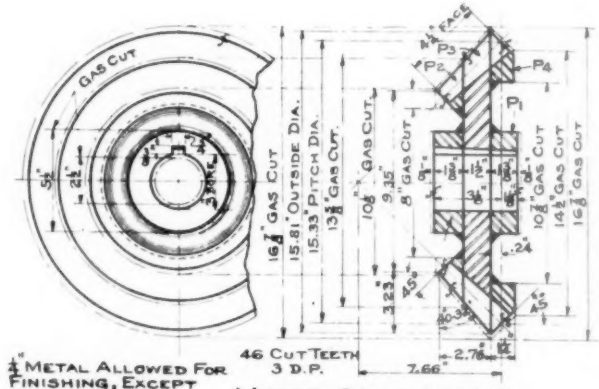
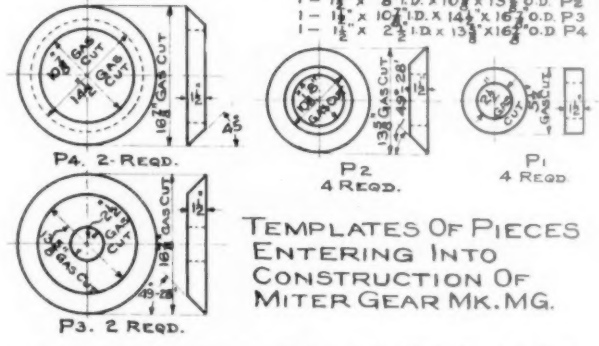


FIG. 4.

MITER GEAR MK. MG.
STEEL PLATE 2 REQD.
LIST OF MATERIAL FOR ONE GEAR.
2 – 1½" x 2½" I.D. x 5½" O.D. P1
1 – 1½" x 8" I.D. x 10⅛" x 13⅜" O.D. P2
1 – 1½" x 10⅛" I.D. x 14½" x 16⅞" O.D. P3
1 – 1½" x 2½" I.D. x 13⅜" x 16⅞" O.D. P4



TEMPLATES OF PIECES ENTERING INTO CONSTRUCTION OF MITER GEAR MK.MG.

Figs. 3 and 4. Templates and Lists of Material for Spur Gear and Miter Gear for Gas Cut and Welded Construction.

machining operations that must precede the assembly of the pieces, should be designated and so ordered by notation on the detail involved.

Practice Illustrated

By way of illustration it will be assumed that the Stand Mk. S1, shown detailed in Fig. 1, has originated in an engineering office having no shop affiliations and is to be sent to various contract weld shops for estimate and quotation and later, by the successful bidder, to one or more plate mills who will be able to furnish the gas cut pieces comprising the detail parts, exactly to the shapes required.

Many contract shops have competent template makers, or layers-out, who could readily take off sizes and shapes of all pieces comprising this part, without a supplementary

pieces are slightly less than the distance betwen the pieces P5 and P6-P7 on the one side and P5 and P8-P9 on the opposite side. This is to permit the pieces P1, P2, P3 and P4 to be set in place between the top and bottom pieces without forcing them into position, in case the top and bottom pieces are welded to the mid rib piece P10 first.

Advantage of List of Material

From the foregoing it will be noted that the list of material serves a very useful purpose in that the exact length of each of the rib pieces is given, which is not easily shown by dimensioning, though the allowance for fitting these pieces without forcing may be noted as information to the template maker and gas cutter. Other

advantages of the list of material are to facilitate the estimation of weights of the several pieces and to further designate any special work that might be required to be done on any one or more pieces, such as is indicated by the mark * and the notes relative to machining.

Gas Cut Beveling

In the lower left hand corner of sheet Fig. 1, is shown the detail of the gas cut bevel on pieces marked *. All pieces marked thus on the detail or in the list of material are to be so bevelled by gas cutting by the same shop or mill furnishing the pieces.

Oversize Backwelds for Finishing

It will be noted on referring to the size of the gas cut bevel in the detail above referred to that it is sufficiently large to permit the deposit of a ½″ weld which will be sufficient weld metal, before machining, so that after machining, a weld of about ⅜″, or the size called for, still remains and serves to hold the pieces together. Such welds are here termed "back welds" to distinguish them from plain or outside welds. Thus the machined surfaces of the part present a continuous and finished appearance after machining.

Indicating Finish

Where no list of material or template sketches accompany the detail it should show in dot and dash lines, the outline of the pieces in the rough or before machining, or the amount of metal intended to be allowed for finishing shall be noted. The conventional mark for designating a machined surface may be used. Sometimes a piece such as P10 may be required to be pre-machined before assembly in order to provide adequate tool clearance in machining and such pre-machining operations shall be duly noted as in Fig. 1 of the detail and when template sketches are provided, as shown on template of P10, Fig. 2.

Indicating Intermittent Welds

As a weld shown in end view only, will be taken by the weld shop to be continuous throughout the length of the piece to be welded, unless otherwise marked, the detail should designate either graphically, as shown by light lines indicating the weld in Fig. 1, or by notation, that they are to be intermittent and if exact length of welds and intervening spaces are desired, it should be so noted on the drawing. When, for sake of appearance it might be desirable to fill the intervening spaces with a smaller weld, the size of that weld should be noted.

Other Parts—Spur Gear

The Spur Gear represented in Fig. 3 is a relatively simple welding, but offers opportunity for errors and consequent delays in furnishing material if not properly and adequately detailed.

The detail proper covers all gas cutting, finish-allowance, welding, machining and gear tooth cutting information and is in itself, entirely complete as a welding detail without a supplementary list of material or template details. Should the two latter not accompany the detail it would be well to employ the use of the piece marks P1, P2 and P3, inasmuch as any of these pieces may be specifically referred to by office, shop, or mill in the event any question or error arises with reference to any one of the pieces after an order to furnish them has issued.

A list of material however, is as useful in welding as in structural detailing. It furnishes a check against the detail, gives the number of pieces required and facilitates ordering, permitting the order clerk to order such parts by simply listing on order instead of by drawing.

The template sketches likewise, serve an important use. Most frequently they occupy less space than the detail part and a print may often accompany a letter requesting quotation making for less bulky or obviating separate package mailing. When this practice is resorted to the number of pieces called for on the template sketch should conform to that called for on the requisition or in the quotation request, so that no question arises on the part of the mill or shop relative to numbers required.

Miter Gear

The practice outlined for detailing, listing and ordering welded spur gear pieces may be followed for Miter Gears a detail of which is shown in Fig. 4. As it is entirely possible to gas cut the bevel discs and rings entering into the construction of the Miter Gear Mk. MG, all figures for gas cutting them are given on the detail of the gear, as is all other welding and machining information.

In the list of material it will be noted that the pieces P2, P3, and P4 are given two outside diameters, which diameters form the beveled outside periphery of the disc or ring which figures check against the detail of the part proper as well as the template sketches.

Both in the detail and template sketches the angles of the bevels for pieces P2, P3 and P4 are given, which information will be useful to the gas cutter in setting his radiograph to cut the bevels required, this being possible in a single operation by setting the flame at the required angle in cutting the circle so that a bevel edged disc is produced instead of a square edged disc such as is required for the spur gear.

Conclusions

It has been the object in the foregoing, summarily to outline the method of procedure for detailing, listing and ordering of machinery parts for welding, as will come under some one of the following conditions:

(1) When it is known by the engineering department in which the detail drawings of weldings originate, that the shop or mill to furnish the material, maintain a template taking service, then the procedure recommended is to detail in full the composite part and omit the list of material and template sketches, unless for some reason of policy it might be desirable to include them.

(2) When it is not known whether or not a shop or mill maintains such service, it will be the best practice to supplement the detail with both the list of material and template sketches in which case it will not be necessary to give any information on the detail that is supplied by the list or sketches.

(3) When the shop or mill supplying gas cut steel pieces for machinery construction, provide a standardized template taking service it will enable engineering offices generally, to adopt the practice as outlined in paragraph No. 1 of this summary. Until such time, however, the more advisable procedure is that outlined in paragraph No. 2.

Studying men for suitable indications that they can make good as welders; directing their early work so that they develop initiative and can work efficiently with a minimum of direct supervision; and taking time to give them thorough training in fundamentals—All this is a combination which has successfully solved the problem of

Training Gas Welders for the Job*

By T. M. Jones†

THIS paper is, of necessity, based on conditions in our own organization. Here the oxy-acetylene, electric and Thermit processes are employed on an extensive range of work, hence our training system must be broad enough to give consideration to all processes and classes of work. Herein we may differ widely in many details with other plans which might be 100% operative under other conditions.

This plan of training, which has been developed, step by step, considers chiefly the following subjects—

1. Selection of suitable material for training.
2. Development of the individual.
3. Thorough practical instruction.

I—Selection of Suitable Material for Training

I, for one, do not believe that a welding unit and a supply of welding rods, even with more or less extensive training, will convert any pipe fitter into a pipe welder or any tin smith into a sheet metal welder any more than a suitable set of wrenches would change any driver of an automobile into a suitable auto mechanic, or a set of surgical instruments, any medical practitioner into a desirable surgeon. Neither has my experience taught me that any operator can master all classes of welding simply because he has had moderate success on a particular class of work.

While there is no question, that welding and cutting equipment tools are "Tools of Progress," provided that proper use is made of them, I am just as certain that this same equipment, has been in many cases, the "Stumbling Block to Progress," through improper use, either due to the lack of proper training of an apt apprentice or through the misapplication of the process by an operator who may have had years of experience, but who, in my opinion, would never be a practical welder.

Having no doubt of our facilities for providing the practical training to suitable apprentices, our major concern is the selection of apprentices who will develop properly through this training.

A new man has seldom come into our organization with the understanding that we would make a welder of him, the general practice being to employ new men merely as helpers. The duties of such helpers naturally lead them into close contact with all three processes of welding, and while in this preliminary contact, they are closely watched by myself and assistants. If, after a reasonable stay in this capacity, these men show a decided interest in any particular branch of our work and our study of them indicates that they are suitably inclined to develop into welders, it is then that the actual training program is started.

This preliminary grading or sorting, we believe, has worked to the advantage of both our Company and the men, since it has saved the Company time and effort in training of men who would not fit into our organization as welders, though at an early stage they could be trained to fit into the organization in some other capacity, as well as helping the men by guiding them into some other job for which they seem better fitted without first having to discourage them by proving to them that they could not master the art of welding.

Though this preliminary check is quite thorough, it is quite possible that we have erred in our judgment in some cases and thus blocked the training of an individual who might have developed into a practical welder. However, I feel that such cases have been so few as to be negligible when compared with the advantage of this practice.

II—Development of the Individual

Our plant is quite large and about one half of our welding force is scattered throughout the plant, since only about 50% of our work is done in the Central Welding Shop. This condition necessitates our placing considerable responsibility in the individual operators. The operators must, in many cases, act on their own initiative, since it is impractical for the field foremen to try to handle all details of work which they are carrying on in their respective territories.

*Paper read before the 32nd annual convention—International Acetylene Association, Chicago, Illinois—November, 1931.

†Superintendent of Welding, Illinois Steel Co., South Chicago, Ill.

As an example, during a construction or alteration job, an operator may be employed erecting some welded piping which has been fabricated in the welding shop. Due to last minute changes in some parts of the structure, it may be found that the piping, as designed, will not clear an obstruction unless minor changes are made in an angle or bend or branch connection. Another case might be a reclamation job wherein an operator might find that a break has extended through a mechanical flange, the question arising as to whether it would be most practical to weld through the flange and re-machine or to back up the weld from the opposite side without disturbing the machined surface. Again it might be some question relating to a detail of safety which has arisen as a result of several minor changes in previous plans.

Minor cases of this kind, we have found can be reasoned out by a thinking welder as well as by his superior and it is in this connection that we do all that is possible to develop a thinking individual along with our efforts of instructing him in the method of doing a particular job.

Our efforts along this line include a school which is in session an hour weekly in the plant. Regular classes are held in shop mathematics and drawing, and all subjects relating to the design, metallurgy and mechanics of welding are freely discussed. This periodical school session is supplemented by several hours' study which is demanded of the students each week. Also in conjunction with the school a rather complete library of various welding publications is made available to the students.

In this same connection we have made an effort toward more advanced interest and training in the important matter of safety.

III—Thorough Practical Instruction

Our method of practical training is probably little different than that employed in any other line of welding. This training includes developing a thorough knowledge of the tools to be used as well as the practical application of them in the welding of steel, the welding of bronze, the welding of cast iron, the welding of non-ferrous metals, the welding of special alloys and hard surfacing materials.

The instruction given in regards to the construction and functioning of equipment is for the sole purpose of providing the operator with a proper knowledge of the equipment so that it will be given proper care in handling, and not with any intent that the operator should make any repairs to the equipment. For various reasons we do not permit apparatus repairs by operators, all such repair work being done by our tool room man who is a practical operator with several years' experience in the field.

Having concluded that an apprentice is best suited for some practical branch of welding, i.e.—Oxy-Acetylene, Electric or Thermit, he now begins to spend most of his time in the chosen line of work. At the outset he may be little more than a helper, but as he gains knowledge of the tools of the trade and their application from this contact he is gradually trained in their practical application. Observation during this shop training gives us further knowledge of the individual so that he can be best fitted into an organization.

Many of these men show a preference for some particular line of work—i.e., pipe welding, sheet metal work or cutting or building up operations, hence many are trained as specialists along these lines. This is possible in an organization such as ours since we have many operators employed at such standard applications continuously. On the other hand we find some apprentices who are not so much interested in perfecting any one operation but who are satisfied to be able to make sound welds of average appearance on some particular job today and whose interests are stimulated by starting on an entirely different job tomorrow. Such men are given required training on all classes of work and in most cases turn out to be all round job welders.

These men we use on our emergency work or on the miscellaneous line of repair jobs that we have to handle. These men are also able to step in and help out with any of the more specialized lines, even though they are not so proficient from the standpoint of speed or appearance of welds.

Though time might be a major factor in many courses of training, we give little consideration to this point, since our main object is to keep our program flexible enough to allow the needed training to each individual, the time ranging from two to four years. However, at the end of this period, the men have usually concluded that they must stay in training to keep up with the developments that seem to continue from year to year.

Metallurgy and Welding

(*Continued from page* 29)

point mixtures (eutectics) which render the metal red-short. The shortness of metals in general is due to some such impurity. Those impurities insoluble in the metal are inert chemically, with one exception, but the general harmful effect is the metallic discontinuity or internal notch at which rupture often starts.

Oxides, which have a tendency to oxidize the metals in which they exist, make up the above mentioned exception. Upon heat treating steels containing iron carbide in contact with oxide inclusions, the compound is decomposed into iron and carbon monoxide. The natural tendency of iron or ferrite to segregate to a network, and its harmful effect are well known.

I believe the fluxes used in welding take no part in the above consideration. They form a protective liquid body above the molten metal and suffer no admixing or emulsification with it. In some cases they even act to attract and remove some of the inclusions already present, both in welded material and welding material.

Fundamentals of Good Welding Practice

In conclusion I wish to state that all of the aforementioned facts are of primary importance when considering welding operations. The best welding material should naturally be identical with the material to be welded, and the best welding practice should be that which applies the metal without decomposition and with but little change in physical structure. In welding in which it becomes necessary to join dissimilar materials, the properties of each should be thoroughly studied both before and after actual welding. Assuming an acceptable weld externally, the first step should be a metallographic examination of the internal structure. It is important that there be no marked differences in grain size at the joint. The individual grains should be more or less equi-axial, and thus show no strain. The non-metallic inclusions should be equal to or preferably less than those found in the original metal. All this presupposes a choice of metals with characteristics which do not vary too widely.

Boston Tunnel Has Arc Welded Liner

(Continued from page 32)

The end plates are fixed by a continuous weld on the outside of the member and machined to insure a good fit and more waterproof connection. A V-joint shown in the sketch, Figure 3, was used.

On each segment there is 36 feet of lineal weld done by the shielded arc process with "Fleetweld" electrodes and Lincoln "Stable Arc" welders. Welding speeds in production are extremely high. A total of 132.72 miles of welding was done on the job.

Ordinary mild steel was used to fabricate the skin plates which were finished and ready for welding after three punching and trimming operations. All the members which compose a single segment were carefully checked to assure uniformity in size, with the result that the entire 19,467 panels are practically interchangeable, as will be seen in Figure 4.

In the field the rings are erected following the usual traveling shield which excavates a tunnel eight inches larger in diameter than the rings. The shield itself was fabricated by arc welding. It is 31 feet in diameter and is driven forward by 32 two-hundred-ton hydraulic jacks. The thrust of the hydraulic jacks used in the traveling shield is taken by the rail stiffeners on each segment.

To insert a ring enough of the extended hydraulic jacks are removed to allow the placing of a single segment. As soon as this is in position the jacks are shortened and placed. The operation is repeated until the entire ring is complete.

The connecting edges of the segments are smeared with a roofer's putty and allowed to stand a week before bolting. There are 72 bolts in each segment and as these are tightened a waterproof connection is insured.

The 4 inches of air space around the rings is filled with dry gravel blown in through the 2 inch pipe taps in each ring. A 1 to 1 grout mixture is then blown in at 100 lbs. pressure to form the concrete outer shell of the tunnel. The inside of the shell is lined with 24 inches of concrete pierced with suitable forms for ventilation and conduits.

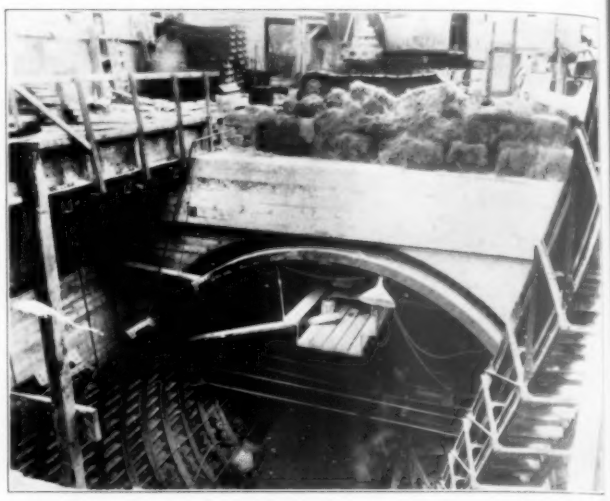


Fig. 5. Finished Segments Going into Place.

A good view of the segments going into place is shown in Figure 5. The photograph was taken at the East Boston side at the first construction shaft.

The tunnel, which is longer than the Alameda tunnel and one foot larger in diameter than the Holland tunnel, is being constructed by the Boston Transit Department, of which Col. Thomas F. Sullivan is chairman; Ernest R. Springer, Chief Engineer; P. L. Giering, Electrical Consultant and L. B. Howe, Designing Engineer.

Building a Job Welding Business

By W. Irving Brockson

XIV. How They Are Doing It in the South

WHAT kind of organization is the job welding shop of the South?

What are (1) the kinds of work done, (2) "side lines" followed, (3) business policies adhered to and (4) sales and advertising methods used?

The people who are "welding minded" will naturally be interested in the answers to these and similar questions, particularly since the eyes of the nation have been turned toward the industrial development of the south during the past decade.

Naturally such questions as these are difficult to answer fully and completely. Nevertheless, some light can be thrown upon them from a trip taken in early summer of 1932 primarily through Kentucky and Tennessee but striking the fringes of other southern states—a trip which included stops in sixteen large and small towns and calls on 42 job welding shops.

After being in business for 32 years the oldest job welding shop in a prominent southern city decided to move from the location which it had occupied from the beginning. In February, 1932 this goal was accomplished and within a very short time the business showed a 500 per cent increase.

This attributed largely to the fact that the company does a great deal of work on trucks and large busses. The original location was in a congested district, the shop was small and the parking facilities were entirely inadequate. The new location is in a less crowded area and there is ample parking space. A scrap iron yard is operated in connection with the welding shop but it is used primarily as a source of spare parts.

Both gas and electric welding are done and a great deal of ingenuity has been shown in the building of a home made portable electric outfit. This machine is operated by an old Chevrolet automobile engine which, together with the electric welding machine, is mounted on a frame of I beams which in turn is placed on Model T Ford wheels and axles. This rig has a record of going 200 miles

on a job. Very recently this organization welded a partition in a large tank, 12 ft. in diameter and 32 ft. long. By way of variety, however, aluminum and pewter are also welded. The personnel of this shop consists of a father, two sons and two other employees.

Variety Is the Spice of Job Welding

Repairing the Liberty Bell of Revolutionary fame would hold no terrors for an enterprising young welder of western Tennessee because his shop has the job of welding a cracked church bell for a negro congregation. If a diversification of work is the key to achievement this company should be a brilliant success, not only because of the variety of welding jobs done but also because of the other activities followed. Welding is done for cotton gins, lumber mills, city water works, general manufacturing plants and farmers. A gas outfit, mounted on a home made two-wheel auto trailer, is ready to go anywhere on a moments notice. Grinding, lawnmower repairs, tool sharpening and similar activities provide a very satisfactory source of revenue. But to satisfy his desires to "go fast" the manager also serves as local sales agent for prominent manufacturers of motorcycles and outboard motors.

Another company, after doing a general welding business for 12 years, is branching out into the manufacture of ornamental iron. This concern is following a most businesslike policy in that it refuses to do work for people whose credit is bad. It is understood that many job shops could well afford to watch this phase of their business more carefully.

Spot welding was encountered very frequently on the trip but one company, primarily a sheet metal establishment, was making excellent use of this process in the manufacture of an oven for electric stoves.

Dick Adams, which, by the way, was not his real name, had no fear of the depression because he began business just about one year ago and has been "breaking even" ever since. Before Dick "forged out on his own" he spent many years in other job shops. He believes that one can get a much better training in a job shop than he can by working for a large industrial concern. The variety of jobs coming up under the latter circumstances is very much more limited. He furthermore believes that the large welding equipment companies have not done the industry any good by placing their outfits in the hands of inexperienced people. In their mad scramble for larger volume of sales these companies have sometimes sold to people entirely untrained and inexperienced. As a result, many poor jobs have been turned out to the detriment of the welding industry at large.

"Two or three years ago I could lay around the shop and enough business would come in to keep us busy but you certainly have got to go out and get it today." So spoke the manager of The Enterprise Company. And to show how he "goes out after it," this manager proudly turned to a relatively new portable electric welder which is operated by an old automobile motor and which has been mounted on a truck with small cast iron wheels so that the outfit can be rolled from a high "parking" platform on to the body of a motor truck. Although this organization specializes on making springs for trucks it also does such work as tank welding, auto repair, small boiler welding, etc. This shop is imbued with the "study habit" because the manager and one of his helpers has the habit of reading The Welding Engineer and the worth while current books on the subject. They are open minded and are glad to get new ideas from any source they can.

"I have been on the job for 15 years, have never taken a day off except Sundays or legal holidays and have never taken a dose of medicine. Welding has never bothered my eyes because I can still read fine print without glasses." This is a testimonial of the operator of a one man shop located in a southern city of much historic fame. Two principal sources of business for this shop are farm machinery and armatures. Despite his success, this gentleman feels that his city still needs to be educated to the value of the welding process.

One company interviewed by your "traveling scribe" does a general electrical contracting business but also operates a job welding plant in addition. Just recently this company has purchased a beautiful new portable electric outfit, mounted by the manufacturer on a special automobile chassis. As a matter of publicity a large sign has been mounted on this portable welding outfit showing the name of the company and some of the kinds of welding done. This concern does both newspaper and direct mail advertising.

One of the largest sheet metal contracting companies in the south has been doing welding for about four years and is studying the process very carefully. They do gas, electric and spot welding. In this case the welding is used primarily in connection with regular sheet metal work but outside jobs are not refused.

In turning away from business for a while it was gratifying to drop in on Berea College, the institution which is doing such a wonderful work for the inhabitants of the mountain districts, to find that gas welding is being taught as a part of manual training courses.

The job welders visited in Memphis were all interested in the success of the Cotton Carnival, a celebration now in its second year and which is a pattern after the famous New Orleans Mardi Gras. Naturally the objective of this carnival is to boost the interests of cotton, the principal crop of the south. The more cotton that is sold the more welding will have to be done on cotton gins and other manufacturing plants.

How They Advertise

A form of advertising which has found favor among many job welders is display space in classified telephone directories, particularly in towns of fifty thousand and more population. It has been found that such directories are actually used by numerous prospects when in need of welding service, and the shop which is listed in bold face type or, better still, has a display advertisement telling something about the kinds of work the advertiser is equipped to do, stands a better chance of receiving a call than those listed in small type furnished free by the telephone company.

Another sales promotion method commonly used is the distribution of manufacturers' literature, including letterheads, blotters, folders, "stuffers", booklets and novelties. In most cases such material is furnished to the welder free of charge and is imprinted with his name, address and telephone number. To be sure, it also bears the name of the manufacturer of gases, electrodes, fluxes, etc., but this is looked upon by the trade in the south as an advantage rather than a disadvantage, because it ties the name of the welding shop in with the manufacturer, who in many cases does a great deal of national advertising and thereby creates an interest in his product.

Welding Instruction in Vocational High Schools

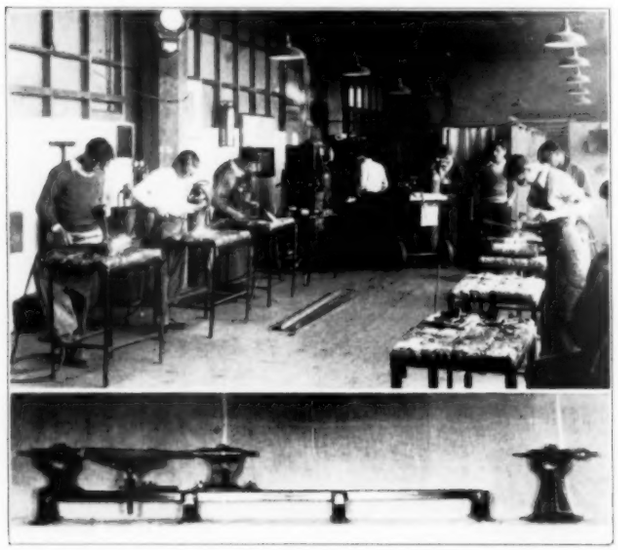
By D. P. Masterson

Welding Instructor, Edison Technical High School, Rochester, N. Y.

With welding coming to the front by leaps and bounds public school authorities have been confronted with demands from various quarters that courses in both electric and acetylene welding be installed in the vocational high schools.

While recognizing the need for training in this new and broad field, school authorities have been slow to install courses, being somewhat afraid of the cost of materials necessary for the successful teaching of this subject.

Actually, this is not as high as it seems. The various dealers give schools bottom prices on acetylene and oxygen while discounts on equipment range as high as fifty percent.



Welding Class at Edison Technical High. Below Are Shown Bench Tools Made by Students.

Arrangements for material usually can be made with some large manufacturing plant in the locality. In Rochester we receive all our material from the Eastman Kodak Company. Some of the materials received from them include: all thicknesses of low carbon steel, cast iron, brass, copper, aluminum, stainless steel, nickel, and all sizes of pipe up to 16 inch extra heavy. The Board of Education truck transports the material from Eastman's and returns it after we have used it. This service costs the city nothing.

The course was installed in the Edison Technical High School at Rochester, New York, three years ago. It immediately became the most popular course in the school, which contains a thousand boys and offers opportunities for learning almost any trade.

The equipment consists of fifteen oxy-acetylene outfits, five electric generators and one atomic-hydrogen outfit.

Evening classes with a registration of twenty are run every night except Saturday and Sunday. Adult classes are also run on Saturday morning and afternoon. These classes are all full and a waiting list is established to fill vacancies. Classes in the evening are of three hours duration. Two hours and a half are devoted to practical work and the other half hour to theory. The course is designed to accommodate the mechanics of other trades.

Steam-fitters and plumbers are confined to the welding of pipe and laying-out and cutting of various pipe joints.

Auto-mechanics have definite jobs directly related to the repair of auto bodies, frames and motors.

Welders may come in and receive special instruction in the welding of any metals or jobs.

A progress card is kept by every member of these classes and on this card is a record of the kind of jobs done, time on the job, appearance of the weld, penetration and porosity. All welds must be checked by the instructor who grades them and marks the student's card.

The boys in day school are regular high school students attending six hours a day. They spend three hours a day in the welding shop and the remaining time attending classes in drafting, mathematics, industrial science and civics.

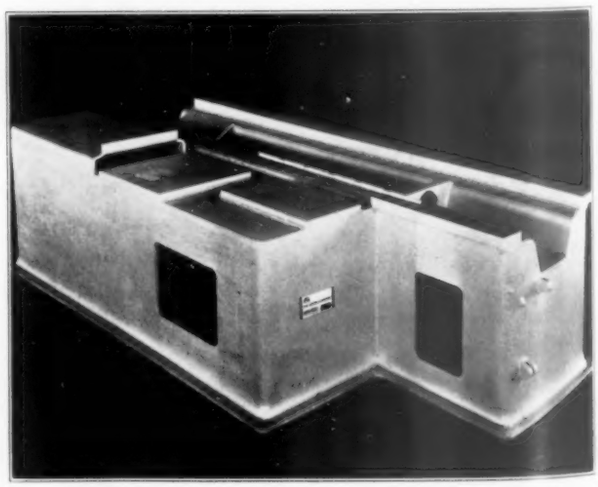
Keeping the boys interested in work that is, of necessity, mostly practice work is a problem in day school. We have met this problem by (1) doing practical work for the other shop in the school; (2) by ornamental iron work and (3) by original designs or redesigns of tools that have previously been made of cast iron.

Some very interesting floor and table lamps have been made by the boys.

In the machine line the boys have redesigned small wood lathes, drill presses, bench vises and grinders. In redesigning these machines for welding the boys are required to make their own working drawings.

We feel that the Vocational School product is destined to fill an important part in the future of the welding trade. Most superintendents of welding plants have had the experience of needing to speed production and usually the quality of the men received through the employment bureau has been of a low standard.

We feel that boys who have been taught to weld all the commercial metals and have a knowledge of drafting and blue-print reading will be far more valuable to the industry than the man who has learned his trade by the pick-up method.



Saw Bed For Multiple Saw Cutting of Synthetic Material. The Advent of the Commercial Jobbing Weldery Gives Such Machinery and Machine Tools New Style, New Strength and Reduced Cost. Photo by Courtesy of Austin Co., Welding Division.

Celebrates Ten Years of Successful Arc Welding

H. C. Price, Inc., Bartlesville, Okla., formerly the Welding Engineering Co., recently celebrated its tenth anniversary at which time it incorporated its present name. Specializing exclusively in electric welding of pipelines the organization is now rated among the largest in the country and enjoys an international reputation.

H. C. Price heads the firm as president and personally supervises all construction work. Other officers are M. L. Price, vice-president and N. E. Ervin, secretary-treasurer. In addition to these, J. M. Price, of New York City, is a director.

H. C. Price

G. W. Fowler is general field superintendent.

Under the name of the Electric Welding Co. Mr. Price started in business in 1922 at Bartlesville, specializing in welding of tanks. In that year he electric welded a 55,000-barrel oil storage tank for the Empire Oil & Refining Co. at El Dorado, Kan., said to be the first time that electric welding was employed on large storage tanks. The company continued tank welding until 1928 when it began to specialize on pipeline work exclusively.

Its work on pipelines included many of the lines of major importance in the last three years. The Continental Construction Corp. 24-inch gas line from the Texas Panhandle fields to Chicago was its largest individual job. The Missouri-Kansas Pipe Line Co. job from Texas to Indianapolis and other cities was another. At one time it employed 375 men with a monthly payroll of $25,000 during those hectic days of pipeline construction last year. Some of its largest oil lines welded included the Texas-Empire Pipe Line Co. and Atlantic Pipe Line Co. lines from East Texas to the Gulf Coast.

From one stationary welding machine in 1922 the equipment of the organization has been expanded to include 82 welding machines, 15 tractors and a large number of motor trucks. During its existence it has purchased and used a total of 156 machines of which 74 were subsequently discarded in favor of new and more modern equipment. It maintains a large warehouse in Bartlesville where this equipment is stored and serviced.

Since 1928 when it began devoting its attention to welding of pipelines the organization has completed a total of 2,500 miles of large diameter pipe. In the last two years alone it has completed more than 136,000 welds, using 1,655,000 pounds or 828 tons of welding wire.

Los Angeles Section Discusses Pipe Line Welding

The Los Angeles section of the American Welding Society held its regular June meeting on the 16th of the month. The meeting was attended by a goodly number of members and guests, and, as usual, was preceded by a plate dinner at the Mona Lisa Cafe.

Ben F. Laulhere, of Los Angeles, construction engineer for the Southern California Gas Company, gave an interesting talk on pipe-line welding, which was one of the main features of the meeting. Mr. Laulhere was formerly with the Southern Fuel Company, of Los Angeles, and had charge of the welding as well as the general construction of that company's 26-in. gas line extending from the Kettleman Hills oil and gas field to Long Beach, which was completed last fall. Mr. Laulhere's talk was a general description of the different processes employed, together with interesting details of the many difficulties encountered by reason of the mountainous terrain, etc., in the welding of that large diameter pipe line. The welding of this line was done by both the electric arc and acetylene processes, with different makes and types of rods being used in the different sections of the line.

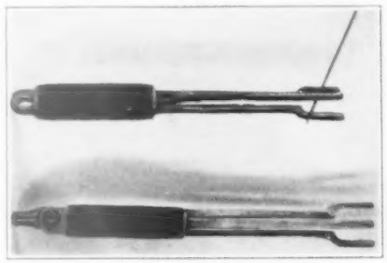
A reel of interesting pictures showing some of the welding operations and other construction scenes on the Southern Fuel line followed Mr. Laulhere's talk.

No meeting is scheduled for the society in July, however, the executive committee is arranging for a number of sessions for the month of August for the special benefit of visiting members from distant points who will be in Los Angeles attending the Olympic Games which will be in progress at that time.

Welding School Serves Many Trades

A folder recently issued by the Smith School of Welding, 250 W. 54th St., New York City, calls attention to the large number of trades in which welding equipment is now commonly used. As an example, it indicates that students who have been trained in the school include union steamfitters, pipe fitters, plumbers, sheet metal workers, blacksmiths, engineers and boiler makers, in addition to the variety of miscellaneous trades, such as aircraft workers, auto mechanics and general mechanics.

As an illustration of the usefulness of welding equipment in the hands of men who have some mechanical ability and ingenuity, there is illustrated an electrode holder recently constructed by students of the school utilizing materials ordinarily found in a scrap pile. The holder was cut to shape from an old automobile bumper, using the cutting torch, and the center prong was bent while hot to accommodate the electrode. The handle was made from an old hammer handle sawed in half and



Electrode Holder Made by Students as Practice Exercise.

taped. The copper terminal was made from 5/8 by 18 gauge tubing, flattened and drilled. This gave the students an opportunity to observe that even the tools of their own trade could be made from available materials in an emergency.

Lincoln Welding School Will Run Special Summer Course

The Lincoln Electric Company, of Cleveland, Ohio, has made plans for a special summer course to be offered to engineering graduates or those who have had sufficient technical experience to understand the meaning of the terms used in engineering practice. Students who take this special course will be required to attend the regular Lincoln Welding School during the day time and to attend lectures two nights a week, given at the John Huntington Polytechnic Institute by E. W. P. Smith, consulting engineer, of the Lincoln Electric Company. This is an advanced course for chief draftsmen, designing structural engineers, machine designers and men capable of taking executive charge of design.

Federal Reports New Appointments and Encouraging Prospects

Arthur Mallett, formerly chief engineer of the Thomson-Gibb Electric Welder Company, Bay City, Mich., and previous to that assistant supervisor of welding developments, Ford Motor Company, has recently joined the engineering staff of the Federal Machine & Welder Co., Warren, Ohio. Announcement has also been made of the appointment of Clyde Coates, formerly designing engineer of the Taylor-Winfield Co., and a man of long experience in welding and hydraulic engineering. In a letter announcing these appointments, M. L. Eckman, of the Federal company, states that the fact of having about three months' work ahead for the plant at the present time is a source of considerable encouragement.

Survey Shows Diversity of Instruction in Technical Schools

A survey recently made by the Lincoln Electric Co., Cleveland, Ohio, to determine the extent to which arc welding is being taught in various technical schools and universities has shown that there is a great diversity of practice throughout the country. In some schools regular welding courses are laid out and in others it

is found that the welding processes are treated casually in connection with other engineering courses. In a few cases the courses are very carefully laid out so as to cover both the fundamental principles and the more important applications. In practically all cases the professors and instructors show a keen interest in the subject and indicate that additional co-operation from the industry toward the establishment of more comprehensive instruction in this subject would be welcome.

Still in Business and Proud of It

One of the oldest gas institutions in the country is the Albany Calcium Light Company, Albany, N. Y. This company was started many years ago when calcium lights were first used in connection with slides shown in theatres. The company now is one of the most prominent local distributors of welding and cutting apparatus, gases and supplies. The accompanying photograph shows one of their

Albany Calcium Light Co. Float in Port Dedication Parade.

new trucks in its carnival dress for the Port Dedication Parade which was held on June 6th. There is a new port in Albany which will accommodate all ocean-going vessels. Even though it has just been formally opened, shipments have been received for the past six or seven months from all world ports.

The special celebration was a two-day affair, including a general parade of over 200 floats the first day and a military parade the second day. On both evenings, the port district was open for inspection and inspected by thousands of people. The beautifully decorated new truck of the Albany Calcium Light Company was topped by a huge model torch, underneath which was displayed the sentence "Our torches helped build the Port of Albany." Storage batteries inside the truck furnished a current of 120 volts for lighting it. In addition to this an arrangement of bulbs and colored gelatin hooked to a flasher made the torch apparently burn with a perfect neutral flame. This ingenious and attractive float toured the streets both evenings and was left parked at the port for several hours with all lights burning.

Welding Fraternity Well Represented in Advertising Club

At the recent election of new officers of the Engineering Advertisers' Association of Chicago, men representing several firms prominent in welding activities were elected to office. W. I. Brockson, of the Steel Sales Corporation, manufacturers of welding wire, was elected president; Milo E. Smith, of the Chicago Bridge & Iron Works, one of the best known tank makers and plate fabricators in the country, was elected vice-president; and A. De Young, of the Whiting Corporation, another concern well known for its outstanding accomplishments in welding, was elected secretary. Among the directors elected were: H. L. De Lander, of the Crane Company, manufacturers of a complete line of welding fittings; W. T. Cordes, of the American Steel & Wire Company, prominent welding wire manufacturers; and Keith Evans, of Jos. T. Ryerson & Sons, well-known steel supply house. The Engineering Advertisers' Association of Chicago is an aggressive group of industrial advertisers which is doing splendid work.

Babcock & Wilcox Get Hoover Dam Job

It is reported that the contract for the outlet welded pipe and penstock for the Hoover Dam project has been awarded to Babcock & Wilcox Company. This job calls for the use of between 50,000 and 60,000 tons of steel plate which will be fabricated into pipe ranging in size from 25 ft. to 30 ft. in diameter, the wall thickness in some cases being $2\frac{13}{16}$ in. It is probable that a portion of the work will be done in the Barberton, Ohio, plant of the Babcock & Wilcox Company and some of it at a plant to be erected one mile from the dam.

According to another recent announcement, the Babcock & Wilcox Company is planning to close its plant at Bayonne, N. J., and transfer the manufacturing operations to the Barberton, Ohio, plant. The plant in New Jersey is well equipped for both welded and riveted fabrication and repair work, but no information has been reported concerning the probable disposal of plant equipment.

Extensometer Tells Yield Point

The Oxweld Extensometer, a new testing device which makes it possible to determine the yield point of specimens being tested in an Oxweld Portable Tensile Testing Machine, has been announced by The Linde Air Products Company, 30 East 42nd Street, New York, N. Y.

The sensitivity of the device is claimed to be such that it will indicate the elongation in a standard A. S. T. M. test specimen occasioned by the heat of the human hand. Although highly sensitive, this precision instrument is simple, rugged, self-contained and self-compensating.

The two points of the extensometer are clamped on the specimen to be tested in such a manner that the elongation between the two points during tension is multiplied in a ratio of 5-to-1 by a lever bar making electrical contact with the micrometer head. The moment of contact is indicated by the flash of a small electric light in the extensometer head. This feature makes it possible for a single operator to determine both the ultimate strength and the yield point of a specimen.

It is recognized by the American Society for Testing Materials that an elongation of 0.01 in. in a 2-in. gauge length indicates the yield point of many materials including structural steel and malleable iron. To determine the yield point with the extensometer it is only necessary to back off the micrometer head two complete turns (0.050 in., which allows for the 5-to-1 ratio in the lever bar) from the zero reading (the point at which electrical contact is broken) for the specimen and apply the load, increasing the tension until the light flashes. The flash indicates that the yield point has been reached, and this may be read from the load indicating device on the tensile testing machine.

Lincoln Announces "Shield-Arc" Welder

The Lincoln "Shield Arc" welder is announced by The Lincoln Electric Company of Cleveland, Ohio. A uniform welding current is one of the outstanding features claimed for the new machine. By leveling the hills and valleys or the rapid fluctuations of the welding current, the "Shield-Arc" is claimed to allow the use of a higher average current per given sized rod

New Lincoln Welder.

which permits a considerable increase in the speed of welding and the amount of weld metal deposited.

The new welder is rated at 40 volts instead of the former 25, thus the machine having a 60% greater kilowatt rating than before. This rating of 40 volts is said to be desirable for use with the shielded arc electrodes recently developed by the same company. Thus the larger capacity of the welder coupled with its higher average currents makes possible new efficiencies in welding with this type of electrode which is being used extensively on and a greater increasing number of welding applications. In addition, improved operating characteristics for welding with bare or washed electrodes are claimed for the machine.

As a result of careful designing, it has been possible to eliminate the necessity for a stabilizer or kick transformer of any nature. The elimination of such losses together with the reduction of other machine losses makes possible approximately 10% higher efficiency at full loads and even more on overloads and also a very much less no load loss

This higher efficiency, the maker explains, shows remarkable results in economy of operation.

The new welder is also equipped with dual control which permits independent regulation of current and voltage which is so necessary and desirable for the best results in welding.

Since with shielded arc welding reversed polarity is widely used, the new "Shield-Arc" machine is equipped with a reversible voltage control which actually reverses the direction in which the current is generated. This innovation eliminates the shifting of cable connections to change the polarity of the welding current. This reversible voltage control is operated by turning a small lever mounted on the front of the control panel. By putting this small lever in the neutral position no voltage is generated so that no current can flow through the welding leads. Also a center reading volt ammeter is mounted on the control panel which immediately indicates whether the machine is operating with positive or negative polarity, as well as volts and amperes.

The control panel is mounted on the machine at a handy height for ordinary control. The front is in a vertical position reducing the possibility of breakage. The control panel has a dead front and no exposed live connection in either the front or back.

As will be seen from the photograph, the upper half of the new "Shield-Arc" welder is entirely enclosed, which not only makes it drip proof, but also prevents any foreign articles from being dropped in the machine to cause injury. The machine is of arc welded steel construction. Also the complete generator field is of laminated construction, being composed of electrical sheet.

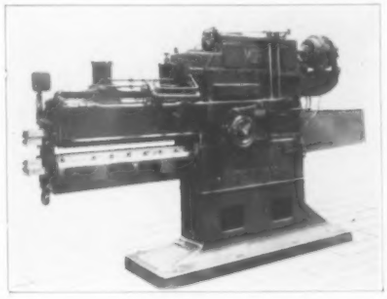
The new "Shield-Arc" welders are built in AC and DC motor driven types of 300, 400 and 600 ampere sizes. Removable running gear and draw bar makes a change from portable to stationary model very easy. The manufacturer reports technical bulletins on the new machine available.

Herculoy is New High Strength Bronze

A new, patented, high strength bronze called "Herculoy" has recently been announced by Revere Copper & Brass Incorporated, New York City. It has a tensile strength comparable to that of low and medium carbon steel, 68,000 lbs. per square inch in hot rolled sheet, 60,000 lbs. in cold rolled sheet, 67,000 lbs. in hot rolled rod and 120,000 lbs. in cold drawn rod. Its resistance to corrosion approximates that of pure copper. The manufacturers state that it can be worked hot very easily by the same processes as steel. It is non-magnetic and is readily drawn and forged. Through proper annealing it is stated that a wide range of physical properties can be obtained. Herculoy is available in sheets and plates, rolls and strips, rods and shafting, forgings, ingots and welding rod. The material is said to be easily welded with a rod of the same alloy.

Flash Trimming Machine

There has been developed by the Morton Manufacturing Co., Muskegon Heights, Mich., a machine for the accurate removal of all of the flash or upset from butt welded or flash welded tanks and sheets. Two rams are provided for removing the flash from both sides at the same time. The upper ram is carried in a guideway which is movable vertically and which also forms the base for securing the upper clamping jaw. The vertical movement is



Morton Flash Trimmer.

accomplished by air cylinders so that sufficient pressure is obtained to securely straighten and clamp the work. This automatically takes care of one of the essentials for close stripping by compensating for any variation in the thickness of the stock. The rams carry a multiple number of cutting tools which are readily adjustable for height. It has also been found practical to use straightening rollers preceding the cutting tools to help take out any warpage which might be caused by handling and welding. The manufacturers state that it has been possible with this design of machine to trim very close to both inside and outside, holding the seam within .01 greater than the metal thickness. The cutting is all accomplished on the draw-cut stroke. The work may be removed while the rams are returning to the outer position. These machines are available in several different sizes and the company is specializing on all kinds of flash trimming.

Ingersoll Announces New Two-Ply Stainless Steel

The Ingersoll Steel & Disc Co., Chicago (a division of the Borg-Warner Corporation) has perfected a two-ply stainless steel. This new metal, to be known as Ingoclad Stainless Steel, is produced by a patented process from the composite ingot.

It is stated that the manufacturing process has been developed to the point where a perfect bond between the stainless steel and the carbon steel back are assured. Ingoclad Stainless Steel is being produced at the New Castle, Ind., plant. It will be marketed at a price which will permit its use for numerous applications which have heretofore been unable to employ solid stainless steels on account of the high cost.

This new stainless steel may be deep drawn, stamped, welded, formed and polished. According to R. C. Ingersoll, president, it is now being produced in various gages and sizes and is being used by several large companies. Facilities will be available in the near future to supply all practical commercial sizes.

Stainless Steel Electrode Announced by Ryerson

Announcement has been received of the production of a new Allegheny metal welding electrode by Jos. T. Ryerson & Son, Inc., Chicago. The electrode is applicable for use with Allegheny metal and other stainless steels in the 18-8 group. The manufacturers state that its uniform and satisfactory performances have been established by tests and that the use of a special flux coating is responsible for the performance. It is stated that when welding with this electrode it is unnecessary to remove the slag from one bead before another bead is deposited on top of it.

Two New Westinghouse Welders

New 300 and 400 ampere gas engine driven FlexArc welders have recently been announced by the Westinghouse Electric and Manufacturing Company. These new welders embody the following distinctive features: full canopy protection from weather, accessible controls, dependable power and transformer type reactance to prevent current surges and electrode sticking.

New Westinghouse Gas Engine Driven Outfit.

Standard units are equipped with large 6-inch rim steel tired wheels. Smaller shop type wheels can be furnished when desired. Also pneumatic and solid rubber tired wheels can be supplied.

Oversize exciters can be furnished to operate small portable tools, such as drills, grinders, buffers, lights, etc.

Bulletin on Manganese Steel Welding Rods

A new, illustrated bulletin has been prepared by Stulz-Sickles Company, 134 Lafayette St., Newark, N. J., describing the manganese steel electrodes and gas welding rods made by that company and illustrating some of the important applications. A bucket tooth job illustrated shows that a repaired tooth is giving better service than a new tooth. It is stated in the circular that about 80 per cent of the manganese steel castings which are being scrapped because they have worn out in service can be reclaimed and returned to service not once, but many times. Some space is also devoted in the circular to woven wire screens made of a special manganese steel wire.

New Booklet by American Optical Company

A booklet entitled *Conservation of Vision in Industry* and devoted to description and discussion of Noviweld glass has recently been published by the American Optical Company, Safety Division, Southbridge, Mass. The introductory portion of the booklet discusses the scientific properties of Noviweld glass. This is followed by an explanation of how this patented glass is adapted to welding requirements. Illustrations show the care used in manufacturing and inspecting. A chart is furnished at the end of the booklet listing the different shades in which this welding lense is furnished, telling the density of each shade and indicating the particular types of welding for which each shade is best adapted.

"Fusion Facts" Appears in New Format

The June issue of *Fusion Facts*, published by the Stoody Company, Whittier, Calif., is a temporary departure from the usual form, being printed on a light tinted paper in two colors and with a change in typography which allows the use of marginal notes to summarize the information obtained in the text. Several pages are devoted to answering a number of questions which commonly arise regarding Stoody products and their applications. The issue also contains some interesting stories and discussions to show the importance of selecting the correct hard surfacing material for each job and of applying each material in the correct manner.

Revere Issues New Catalog

Following its custom of issuing catalogs semi-annually, Revere Copper & Brass Incorporated has mailed to the trade its July 1st issue.

As usual, the catalog is a completely bound book, with the whole story regarding any one form of product being placed on two facing pages. Buyers will find this very convenient for quick comparison.

The page size has been increased from 7¼x9 inches to 8½x11 inches, which permits of easier reading and filing.

British Murex Appoints S. E. Evans

Experts claim that more rapid progress in the adoption of electric arc welding in ship construction is greatly dependent upon the correct design. In view of this Murex Welding Process, Limited, London, England, announce that they have appointed S. E. Evans, A. M. I. N. A., to act as naval architect and expert on welding matters in relation to shipbuilding. Mr. Evans took up his appointment at the beginning of the present month.

Stanley E. Evans comes to London from the Wallsend Shipyard of Messrs. Swan, Hunter & Wigham Richardson, Ltd. His experience in the design of ship construction covers all kinds of mercantile ships, ocean liners, tankers, cargo vessels, small craft, etc., and in addition he has had experience in general marine construction such as the building of floating docks, caissons, etc., for which Messrs. Swan Hunter & Wigham Richardson, Ltd., are famous.

While at Wallsend Mr. Evans was the official responsible for the recent British naval vessels built at that yard.

For a considerable period he has been extensively engaged on welding research for his late firm and the extensive application of welding carried out by them to structures such as deck houses, etc., has gone a long way to clarify the technique required to advance the general application of welding to structural work.

Canada Issues Special Dispensation for Purchase of Welded Pressure Vessels

Until a very short time ago, no welded pressure vessels of over 100 pounds per square inch working pressure (outside of the railway industry) were permitted in the Dominion of Canada. For years the authorities have contended that vessels of riveted construction were more satisfactory, and they have been reluctant to test out or adopt modern methods of welded construction. However, by a special dispensation, the Province of Quebec has recently allowed the British-American Oil Refineries to purchase five vessels of welded construction for tentative tests and observation. The first shipment of these high-pressure welded vessels was made recently when two oil refinery bubble towers and three separators were sent to the British-American Oil Company at Montreal, by the refinery and gasoline plant division of Black, Sivalls & Bryson, Inc., Bartlesville, Okla. The vessels were welded in the shop of the American Tank & Equipment Corp., at Oklahoma City, Okla., a subsidiary of Black, Sivalls & Bryson, Inc.

This is to be a test case. The construction of the vessels was carefully watched during their welded fabrication by a Canadian representative, and their behavior after installation will be carefully recorded. If the welded vessels prove satisfactory, the boiler code will be so revised as to permit welded vessels for high pressures under definite conditions of manufacture. If the vessels do not prove satisfactory, welded vessels will be excluded from the Dominion.

With this in mind, Joseph E. Verden, assistant chief examiner for the Board of Public Works of the Province of Quebec, went to the American Tank & Equipment Corporation's plant in Oklahoma City and remained there during the entire process of fabrication of these welded vessels. It is said that steps are soon to be undertaken in Canada for a revision of the code to include welding.

British Prepare for Age of Welded Ship

By A. C. Blackall

Believing the welded ship to be the vessel of the future, the British shipbuilding industry thoroughly realizes the necessity of preparing for it. A move in this direction has been started on Tyneside, England's greatest shipbuilding center, which is calculated to go to the root of the matter. This is the training of boilermakers in the art of welding.

From a fund established by Sir James Knott, Bart., in memory of his two sons killed in the war, the out-of-pocket expenses of 12 ex-service unemployed boilermakers are being provided for while they receive training in the theory and practice of electric and oxy-acetylene welding in the works of the Premier Electric Welding Co., Newcastle. These twelve men will be given a month's training, which is considered adequate for a skilled boilermaker, and then their places will be taken by another batch of 12, and so on, until in a few months' time a squad of boilermakers equal to tackling any job that comes along will be duly qualified to do the work. As a result of this excellent idea having been set in operation, the Tyneside shipbuilding district will soon be equipped with a staff of skilled welders to be at the disposal of any concern which has the good fortune to book an order for a welded ship.

Nearly Three Hundred Exhibitors Signed Up for Power Show

As a confirmation of the reports that business is showing an improvement which has come from many firms, there comes to us the announcement that 293 manufacturers of power producing machinery, mechanical devices for power transmission, precision instruments for the control of combustion, pressure, volume, flow and other measurable entity, material handling equipment, heavy electrical machinery, etc., etc., will stage exhibits in the forthcoming Tenth National Exposition of Power and Mechanical Engineering at the Grand Central Palace next December.

NEMA Welding Group Meets in New Jersey

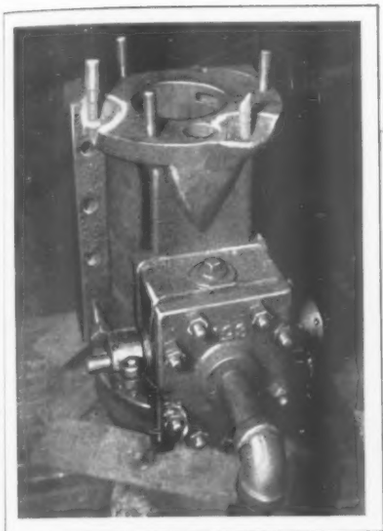
The Welding Machine Division and the Wire Processers Division of the National Electric Manufacturers' Association held a meeting on July 14th and 15th at the Maplewood Country Club, Maplewood, N. J. Arrangements for entertainment and recreation at the club were made by C. J. Holslag, member. The two days will be devoted to consideration and discussion of standards and questions of rating of machines. It is expected that there will be about thirty members present to attend the meetings and enjoy the recreation facilities which have been put at the disposal of the group.

News of the Industry

W. J. Chesak, Secretary-Treasurer of the Modern Engineering Company of El Paso, Texas, was recently elected President of the Lions Club of El Paso.

Bastian-Blessing Company has announced the appointment of Harry Solomon as District Manager in the eastern territory. Mr. Solomon is well known in the industry and has been connected with it for nineteen years. Since 1919 he has been operating the National Welding Equipment Company, Syracuse, N. Y., handling a complete line of equipment and supplies in the eastern territory.

Second fracture proves efficiency of Tobin Bronze welds in iron castings



To eliminate machining on the repaired cylinder, the weld was built up around threaded carbon sticks, which were later burned out.

The fracture on the cylinder head, shown prepared for welding, did not penetrate the original Tobin Bronze weld.

THE housing and cylinder head of this steam pile driver had been fractured previously and repair welded with Tobin Bronze. Then, when a wrist pin broke, the housing sustained two deep fractures directly opposite the one previously repaired. The cylinder head was fractured in two places, the cracks running up to the welds already made, but not penetrating them. The course of the second fractures proved that the Tobin Bronze bonds made after the first accident were stronger than the castings. The cylinder itself, uninjured in the former break, was badly broken around two stud holes.

Of course Tobin Bronze welding was used again. Preparation by chipping was completed by two men in seven hours. Actual welding was done in about three hours with one man handling the welding torch. Preheating was unnecessary, although a second torch was played on the area during welding. The work was done by an experienced welder who estimates that the cost of the repair with Tobin Bronze was only one-third what it would have been had ferrous rods been used.

For further information on Tobin Bronze and other Anaconda Copper-alloy Welding Rods, ask for Publication B-13.

There is a suitable Anaconda Filler Rod for every bronze-welding purpose. Principal Anaconda Welding Rods, with their melting points, are listed below:

For Oxy-Acetylene Welding

Tobin Bronze*	1625° F
Manganese Bronze	1598° F
Brazing Metal	1634° F
Electrolytic Copper	1981° F
Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

For Arc Welding

Silicon Copper	1981° F
Phosphor Bronze	1922° F
Everdur*	1866° F

*Reg. U. S. Pat. Off.

ANACONDA
from mine to consumer

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Connecticut
Offices and Agencies in Principal Cities
In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ontario

ANACONDA WELDING RODS

Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—$1.00 per line, minimum 4 lines.
Count 8 words to line. Add 6 words for keyed address.

FOR SALE

For Sale—Eight 300-lb. Davis-Bournonville acetylene generators never used, price $250.00 each. Address Medicinal Oxygen Co., 1718 Vine St., Philadelphia, Penn.

For Sale—Lincoln and Wilson arc welders; 3 phase; latest type push button control; 95% new; Lincoln machine $460.00; Wilson machine $360.00; also one USL with DC motor drive, like new, $200.00. All machines complete with leads, starting boxes, etc. Pavlik Brothers, Kenilworth, Ill.

POSITIONS WANTED

Combination Welder—Experienced in all applications of gas and electric welding. Qualified to take charge of jobs. 14 years experience. Address M. L. Rogers, The Welding Engineer.

Combination Welder, Cutter and Layout Man well trained in schools and shops; familiar with tools, jigs and fixtures, design and fabrication, factory maintenance, alloys, hard facing, etc. Address Box 471, The Welding Engineer.

Welder and Machinist—12 years welding experience. Familiar with repair of all kinds of large and small machinery. Can do gas and arc welding, brazing, hard facing, high pressure work. Experienced in shielded arc. Good references. Address Box 472, The Welding Engineer.

General Oxy-Acetylene Welder—Experienced in production and repair of all forms of mild steel; brazing, cutting and overhead work included. Will go anywhere. Address H. Douglas Hicks, Brookville, Ohio.

Structural Engineer and Sales Manager—Familiar with structural steel and ornamental iron work. Desires to form a connection with a manufacturer specializing in, or wishing to specialize in the manufacture and erection of structural steel and ornamental iron by welding methods. Would desire to make some investment. Address Box 461, care The Welding Engineer.

Combination Welder—Experienced job shop, production, maintenance, refinery, and pipe work. Anxious to get work locally and elsewhere. L. H. Perkins, 4408 N. 28th St., Omaha, Neb.

NEWS OF THE INDUSTRY

Bass Foundry and Machine Co., Fort Wayne, Ind., have issued a four page bulletin which describes and illustrates the Bass "90" welded steel heating boiler for firing with a gun type oil burner. The boiler is of all welded steel construction in accordance with the A. S. M. E. Code for Steel Heating Boilers.

The Owl Welding Works, at 3650 S. Soto St., Los Angeles, Cal., recently built a new addition to their shop. The addition is about 30 by 30 feet and contains a door 14 feet wide and the same height for bringing large jobs into the shop. S. F. Bradford and S. Hensley, partners, own and operate the shop.

A. G. Odell, Director of Welding, Denver Public Schools, Denver, Colo., has again been appointed a member of the summer faculty of the Colorado Agricultural College in the capacity of teacher-trainer. Methods of teaching both gas and arc welding will be covered in the course which will be under his direction.

It is reported that E. Walters has been appointed special agent in the Chicago territory for Wilson Welder & Metals Company, North Bergen, N. J. Mr. Walters will have his headquarters in connection with Jos. T. Ryerson & Son, Inc., Chicago.

A press dispatch from the Canadian National Railway states that the Anaconda American Brass Company will have a new tube mill in full operation at Toronto, Canada, by July 1st. The mill will produce copper and brass tubes from ⅛" outside diameter to 5" inside diameter, the production amounting to about 150 tons of tubing per month.

Russell Johnson, proprietor of the Johnson Machine Works, Chariton, Iowa, is to add to equipment and plant during the summer months. The shop at North Eleventh street is to be entirely remodeled and a new addition built. Electric welding equipment is to be installed, as is a new 3-ton crane, hydraulic planer, punch, press and other equipment.

G. W. Swan, District Manager of John A. Roebling's Sons Company at Buffalo, N. Y., who is well known for his active participation in the American Welding Society activities in that city, has recently been elected President of the Engineering Society of Buffalo. H. M. Sharp, Chief Engineer of the Buffalo General Electric Company, is Vice President.

R. E. Kinkead, Consulting Engineer of Cleveland, has an interesting article in the May 23rd issue of *Steel*, discussing the probability of modifications being needed in the welding code for pressure vessels and some of the present trends in welded construction in this work.

P. R. Mallory, Inc., Indianapolis, Ind., manufacturers of Elkonite, are mailing out an attractive circular listing the types of service for which they are prepared to furnish special metals and alloys.

The California Division of H. C. Price, Inc., announce they have been awarded the electric welding contract for the 8 miles of 16" gas line being laid by the San Diego Consolidated Gas & Electric Company from near La Jolla to San Diego.

The Barker Poultry Equipment Company, Ottumwa, Iowa, has added to its equipment and is now in production on a new type of all-metal milk crate. Welding has entered into the manufacture, the outside frame and corners being of heavy steel electrically welded in one solid piece.

Shop quarters in the Cook building, Bloomfield, Iowa, have been leased by C. L. Spillman who has opened a machine and welding shop. He has been engaged in business for 15 years and in his present location will do work in all machine lines.

Dallas Welding Works, Dallas, Tex., is the new name of the Metal Welding Co. of that city.

Auto Cylinder Works, Drumright, Okla., has been organized by Ralph G. Oler to operate an automotive machine and welding shop.

NATIONAL (TRADE MARK) CARBIDE

Quality Coke
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The name "Commercial" has been associated with dissolved acetylene since the beginning of oxy-acetylene welding.

"Commercial" is known for its RELIABILITY, UNIFORMITY, PURITY and its ORGANIZATION for service to the industry.

Whatever your gas requirements, you should know about our sales plan. Ask our nearest office to tell you about it.

Supplied in the following size cylinders:

10x30 in. size—125 cu. ft. cap.
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[We also sell oxygen and a complete line of Oxy-Acetylene Apparatus and Supplies.]

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Acetylene Supply Co., Inc.
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Announcement has been made by the Columbia Steel Company, Pacific Coast subsidiary of the U. S. Steel Corporation, of the recent appointment of Ambrose N. Diehl to the presidency of that company. Mr. Diehl recently arrived from New York, and will succeed A. T. DeForest, recently retired. The Columbia Steel Company has been very active in the promotion and development of welding in California metal manufacturing industries.

J. C. Gordon, petroleum and welding engineer, formerly associated with the Pure Oil Company in Oklahoma and Texas, has joined the engineering staff of Black, Sivalls & Bryson, Incorporated, designers and manufacturers of quality welded oil refinery and gasoline plant equipment, pressure vessels, etc. Mr. Gordon will headquarter at Fort Worth, Texas.

The Hasty Welding Works, of San Diego, California, recently completed an important welding job for the city of San Diego in the electric welding of several hundred feet of 18-inch water main in connection with new state highway construction work. Bell and spigot joints were used, Weldite, $\frac{3}{16}$-inch coated welding rod being employed in the welding. Mr. Hasty has a six-month contract with the city for maintenance and repair welding on the city's water lines.

Welding will be employed very extensively in the construction of a 4,000,000-foot gasoline plant by the Excelsior Refining Company, in Rusk County, of the great East Texas oil field. Enlargement of the plant is provided for as increased gas deliveries from the adjacent field warrant. Both acetylene and electric processes of welding will be employed in the construction of the plant and installation of equipment.

G. W. (Buck) Carl, welding engineer for the Union Oil Company of California, is spending his annual vacation with friends and relatives in northern Arkansas. Mr. Carl has charge of the welding department for the "Union" in their shops located in the Santa Fe Springs oil field.

The Masters Welding Works of Signal Hill, California, formerly located at 2854 Cherry Avenue, have recently been moved to a new location at Willow Street and California Avenue in the Signal Hill oil field. W. A. Masters is manager of the shop, in which will be continued the servicing of oil well digging bits together with other general oil field job welding.

J. G. Steele, of Long Beach, California, formerly with the Irwin Welding Works in the Signal Hill oil field, recently opened a welding department in the plant of the Caltex Boiler Works at 2409 N. Orange Avenue, Long Beach. Mr. Steele will feature general oil field welding of all kinds.

W. C. Thorn and J. A. Wright recenty opened a new oil field job welding shop at 17th Street and Main, in Huntington Beach, California. Mr. Thorn was formerly production superintendent for the Continental Oil Company in the Seal Beach (California) field, and Mr. Wright was formerly in charge of the welding department of the Huntington Beach Machine & Welding Works. The new shop is equipped with both acetylene and electric equipment and will feature general welding. The shop will be operated under the name of the "W & T" Welding Co.

S. R. Bowen & Co., manufacturers of welded oil well tools and doing general oil field welding work, is opening a branch shop in Bakersfield, California. The new shop will feature a general welding service for the Kettleman Hills oil field in addition to distribution of their products in that and other nearby fields.